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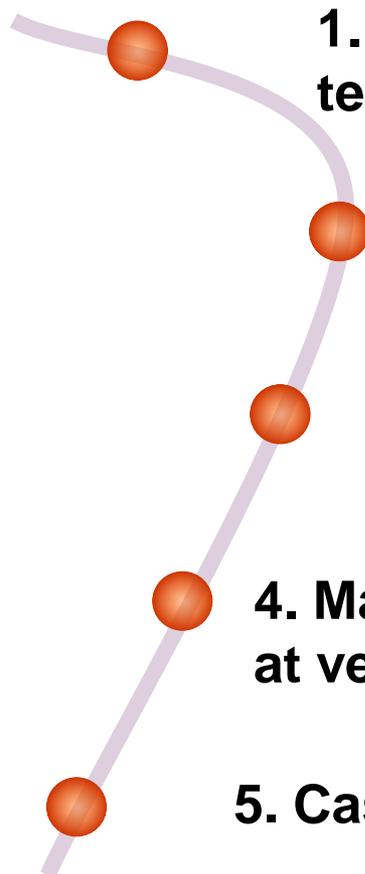
info@ndt.it

***Liquid penetrant and magnetic
inspection at very low or very high
temperatures: safety and
productivity innovations***

Norwegian NDT Society Annual Conference

Stavanger, Norway, October 5th 2021

Agenda

- 
- 1. ISO 3452-5: Penetrant testing at temperatures higher than 50 ° C**
 - 2. ISO 3452-6: Penetrant testing at temperatures lower than 10 ° C**
 - 3. ASTM and ASME Standards
“at non standards temperatures”**
 - 4. Magnetic particles and ultrasonic testing at very high or very low temperatures**
 - 5. Case studies and Conclusions**

About us

Quality Pioneers: 70 years of experience in NDT

- NDT ITALIANA works since 1952 in the field of NON-DESTRUCTIVE TESTING. The headquarters are in Italy near Milan. A large area is devoted to production and goods stocking, to guarantee quick supply to customers worldwide
- NDT Italiana is certified UNI EN ISO 9001 and approved NATO AQAP-120, and is equipped with internal Chemical and Electronic Laboratories, Technical Service, Specialised Consulting at the service of our customers



NDT founder, Mrs. Angela in 1952



NDT factory in Italy, near Milan



About us

Selling in over 100 Countries

- NDT ITALIANA with its products and instruments meets the requirements of many key industrial sectors with turn-key solutions



- NDT Italiana's Products are sold in:

Albania, Algeria, Angola, Argentina, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Belgium, Bolivia, Bosnia Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Colombia, Congo, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Equatorial Guinea, Estonia, Ethiopia, Finland, France, Germany, Great Britain, Greece, Holland, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Ivory Coast, Japan, Jordan, Kazakhstan, Kenya, Kosovo, Kuwait, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Malaysia, Mali, Malta, Morocco, Mexico, Nepal, New Zealand, Nigeria, North Korea, Norway, Oman, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sudan, Sweden, Switzerland, Syria, Taiwan, Thailand, Trinidad, Tunisia, Turkey, Ukraine, United Arab Emirates, United States, Venezuela, Vietnam, Zimbabwe.



About us

Products approvals

- NDT ITALIANA's products are approved by international third parties
- NDT ITALIANA'S products are supplied with certificates of conformity to EN-ISO, ASTM, ASME...



The following sensitivity levels were determined:

Penetrant System IIAe	sensitivity level: 2
Penetrant System IICe	sensitivity level: 2 within the product family

Inspection Certificate

Order No.: 20161483-2
 Applicant: NDT

Date of Application: 27.09.2016
 Content of the Application: Type Testing acc. to DIN EN ISO Standard 3452 Part 2 dated March 2014 of a Colour contrast Penetrant.

Penetrant: Elite K71B2p Batch: 160531P

Hannover, 15.11.2016

Head of chemical laboratory
Helde Kühn
 Helde Kühn

5. Summary:

In view of the investigation results, the tested requirements according to the DIN EN ISO Standard 3452, Part 2, Issue March 2014, have been met by the penetrant testing material.

The test object: Batch:
 Elite K71B2p 160531P

can be identified as "low in sulphur and halogens" according to the DIN EN ISO Standard 3452, Part 2".

Safer Products – the BIO line

The new international safety markings GHS CLP

Regulation n. 1272/2008 CLP (Classification, Labelling and Packaging) and GHS (Globally Harmonized System of Classification, Labelling and Packaging) guarantee a better comparison between chemicals producers worldwide

Elite Bio NDT Products

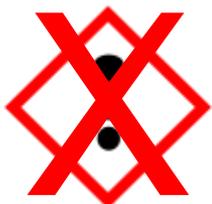
Standard NDT Competitor Products



GHS02



Flammable



GHS07



Xi Irritant



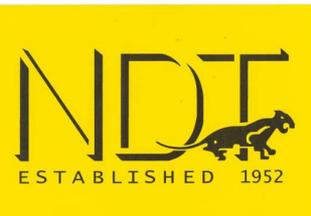
Xn Harmful



Environmental Hazard



Penetrant and Magnetic Bio products are not flammable, not harmful, not even irritant for the eyes or the skin, not polluting for the environment



Customers references

Proud suppliers of all leading companies worldwide





EN ISO Standard 3452-5

Penetrant testing at temperatures higher than 50 ° C

Standard temperature conditions:

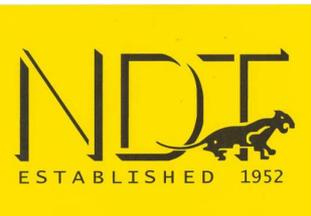
- Between 10°C e 50°C (EN ISO)

UNI EN ISO 3452-5:

PROCEDURE FOR QUALIFICATION

Qualification tests are carried out by the manufacturer and if products are used within the stated range, no further tests are needed on site. 

Testing products shall be at room temperature prior to application, unless otherwise stated by the manufacturer. During the procedure detailed below the test block temperature shall not fall by more than 10 °C.

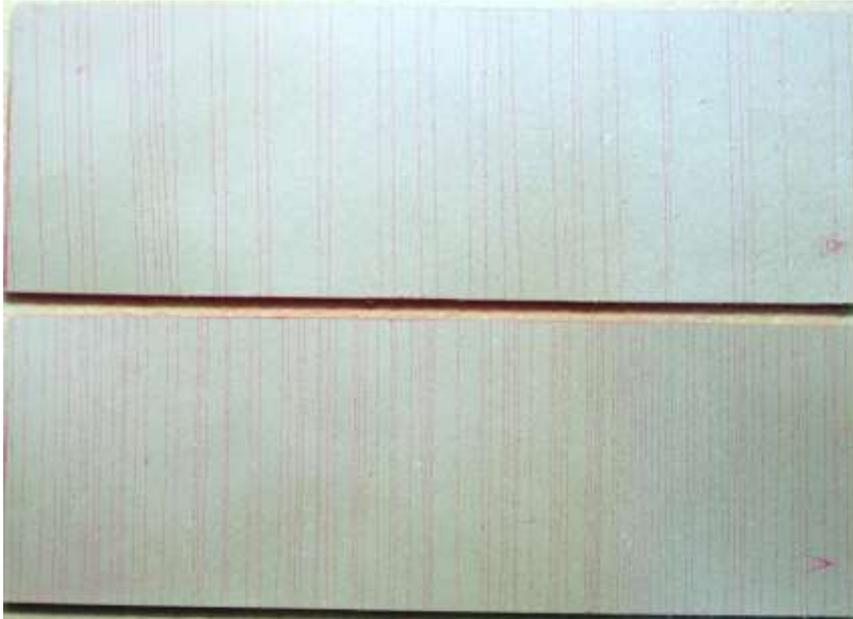


Liquid Penetrants up to +100° C

Qualification Tests (Ref. Block Tip 1 ISO 3452-3)

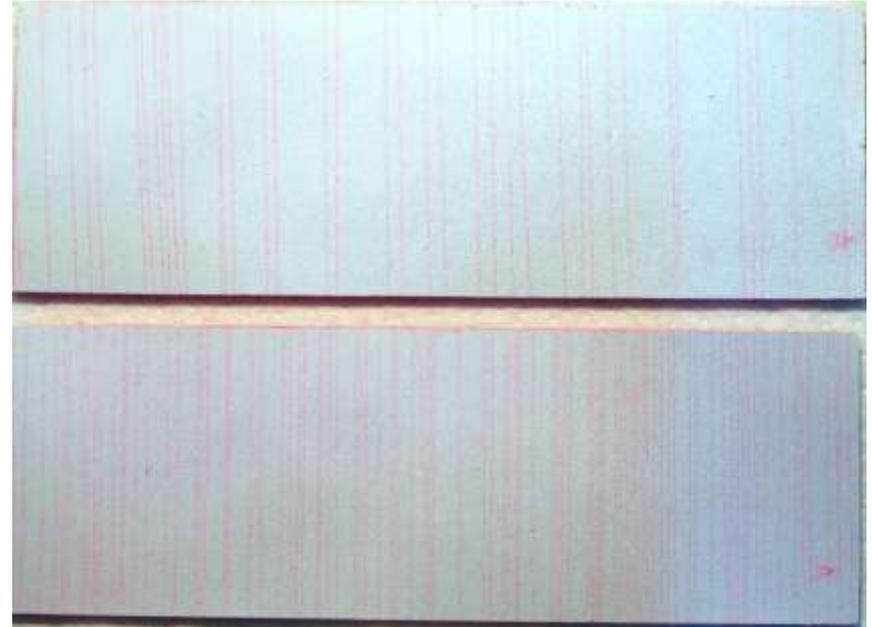
Liquid penetrants tested at standard and high temperature

10°C<T<50°C 50 micron



10°C<T<50°C 30 micron

+ 100°C 50 micron



+ 100°C 30 micron

Red Penetrant Elite K71B2p, White Developer D112A and Bio Remover/Cleaner BC1 are qualified up to +100°C (tested according to ISO 3452-5)

Standard temperature conditions (according to ASME/ASTM):

- Between 40°F e 125°F (5°C e 52°C)

ASME Art. 6 Appendix III :

the test results obtained in accordance with II-640. These records shall be maintained as required by the referencing Code Section.

APPENDIX III — QUALIFICATION TECHNIQUES FOR EXAMINATIONS AT NONSTANDARD TEMPERATURES

III-610 SCOPE

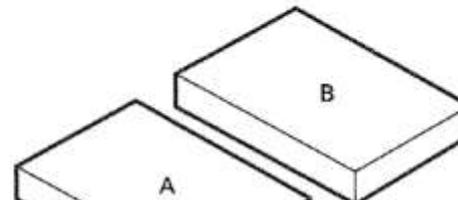
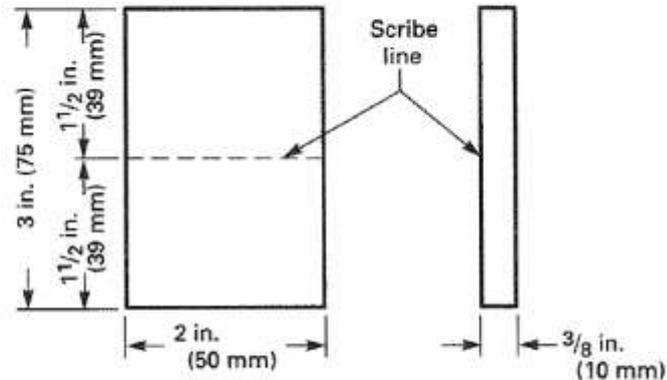
When a liquid penetrant examination cannot be conducted within the standard temperature range of 40°F to 125°F (5°C to 52°C), the temperature of the examination shall be qualified in accordance with this Appendix.

III-630 MATERIALS

A liquid penetrant comparator block shall be made as follows. The liquid penetrant comparator blocks shall be made of aluminum, ASTM B 209, Type 2024, $\frac{3}{8}$ in.



FIG. III-630 LIQUID PENETRANT COMPARATOR
(NOTE: Dimensions given are for guidance only and are not critical.)





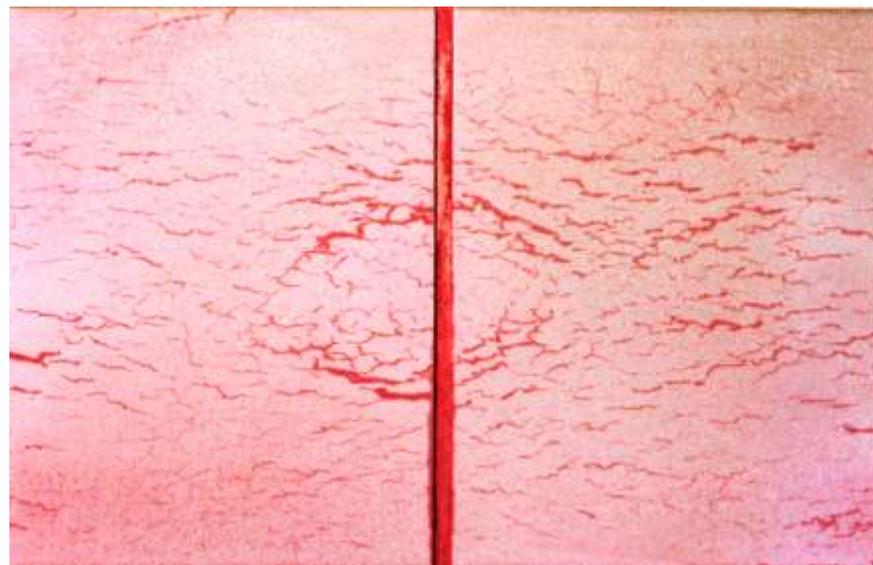
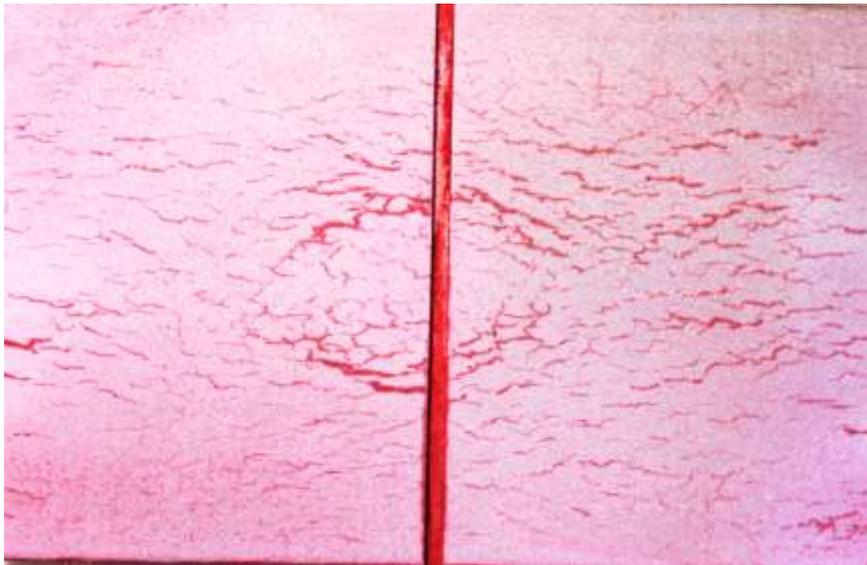
EN ISO Standard 3452-5

Penetrant testing at temperatures up to 200 ° C

Red Liquid Penetrant Elite K71HT is qualified “ IIACcde - 2/10° C- 200° C ”

Temperature 10°C

Temperature 200°C



Red Penetrant Elite K71HT, White Developer D200 and Remover/Cleaner RHT are qualified 10° to +200°C



EN ISO Standard 3452-6

Penetrant testing at temperatures lower than 10 ° C

Standard temperature conditions:

- Between 10°C e 50°C (EN ISO)

UNI EN ISO 3452-6:

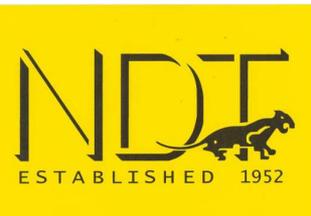
3 Low temperature penetrant testing

3.1 General principles

The general principles of ISO 3452-1 shall apply unless otherwise stated in this part of ISO 3452 or in the manufacturer's instructions.

Qualification tests are carried out by the manufacturer and if products are used within the stated range, no further tests are needed on site.





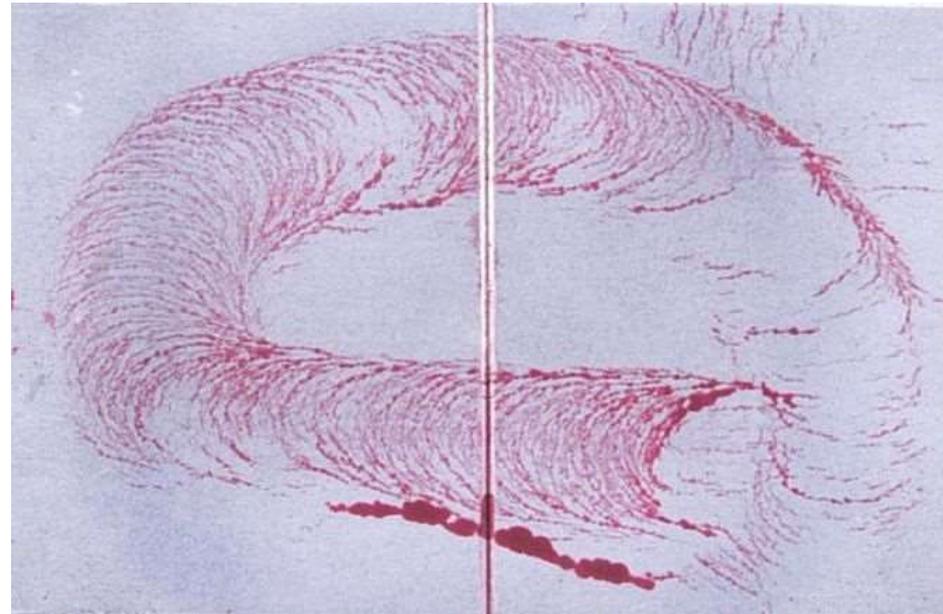
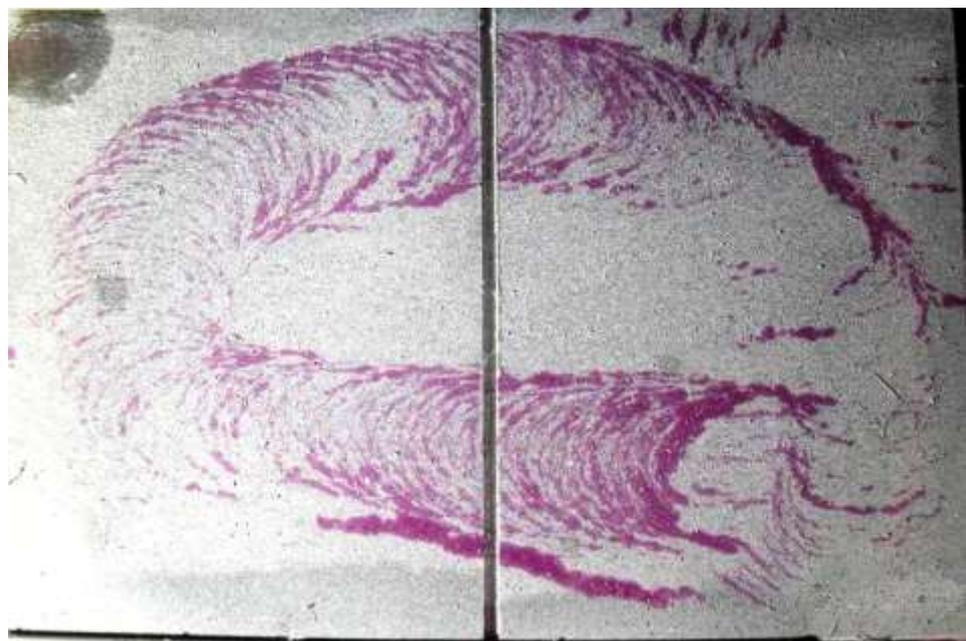
Liquid Penetrants from -10 ° C to +100° C (Extended Temperature Range)

Qualification Tests (Aluminum blocks ASME)

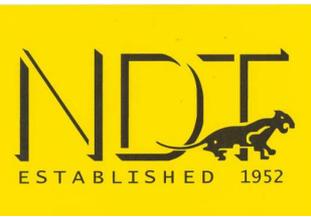
Red Penetrant Elite K71B2p is qualified “ IIACcde - 2/-10° C + 100° C ”

Temperature -10°C

Standard Temperature (>10°C)



Red Penetrant Elite K71B2p, White Developer D112A and Bio Remover/Cleaner BC1 are qualified -10° to +100°C

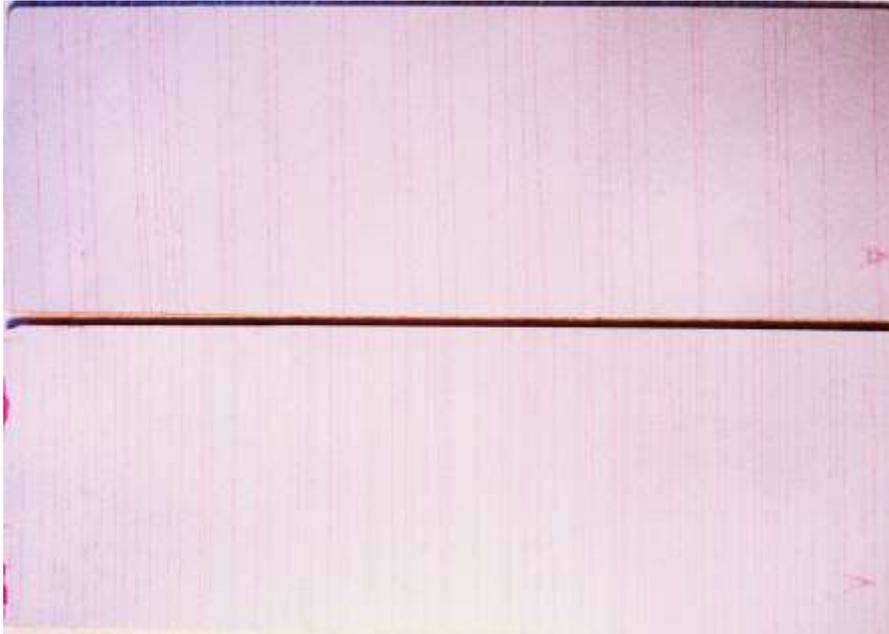


Liquid Penetrants from -10°C to $+100^{\circ}\text{C}$ (Extended Temperature Range)

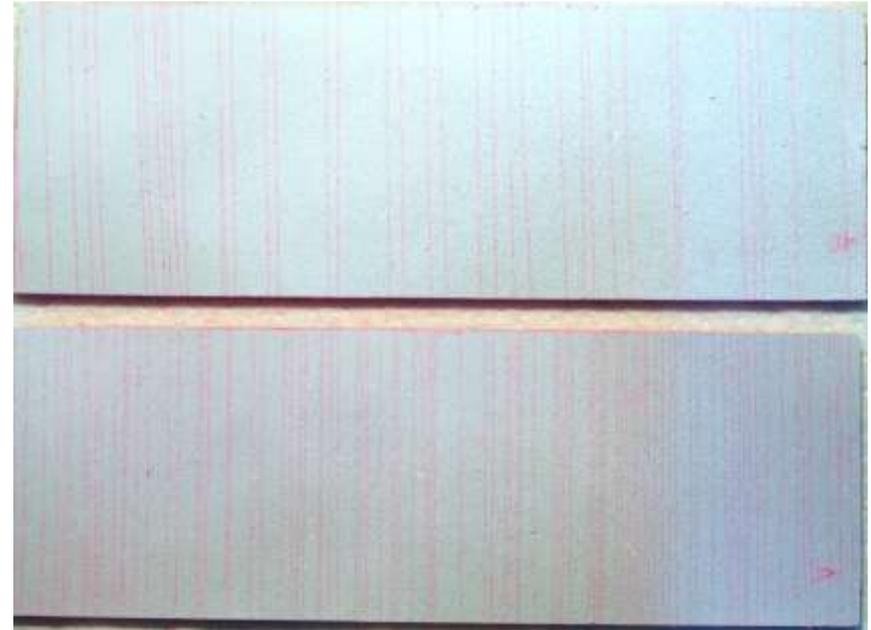
Qualification Tests (Ref. Block Tip 1 ISO 3452-3)

Liquid penetrants qualified for an extended temperature range

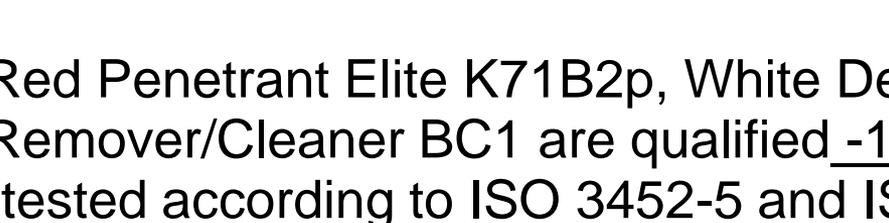
-10°C 50 micron



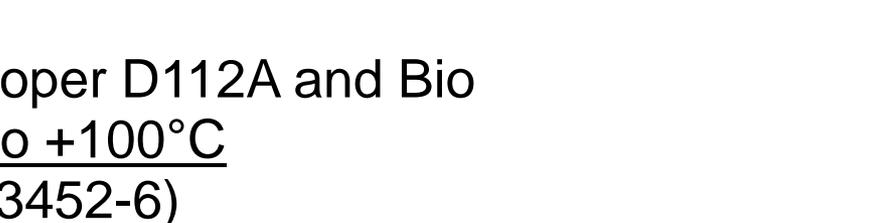
$+100^{\circ}\text{C}$ 50 micron



-10°C 30 micron



$+100^{\circ}\text{C}$ 30 micron



Red Penetrant Elite K71B2p, White Developer D112A and Bio Remover/Cleaner BC1 are qualified -10° to $+100^{\circ}\text{C}$
(tested according to ISO 3452-5 and ISO 3452-6)



White developers at very high or very low temperatures

UNI EN ISO 3452-2 point 6.15; ASTM E1418 Par. 7.1.7.2

- Developers must be qualified together with their companion penetrant to be able to use them at high or low temperatures. Example:
 - From -10°C to 100°C:
 - Developer for d,e D112A can be used (solvent based wet non-aqueous)
 - Da 100°C a 200°C:
 - Some developers are qualified especially for very high temperatures (example Elite D200) or some developers form c can be used (water based)

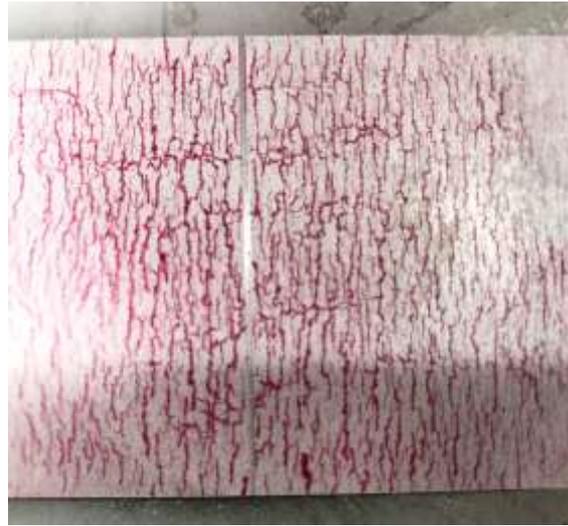
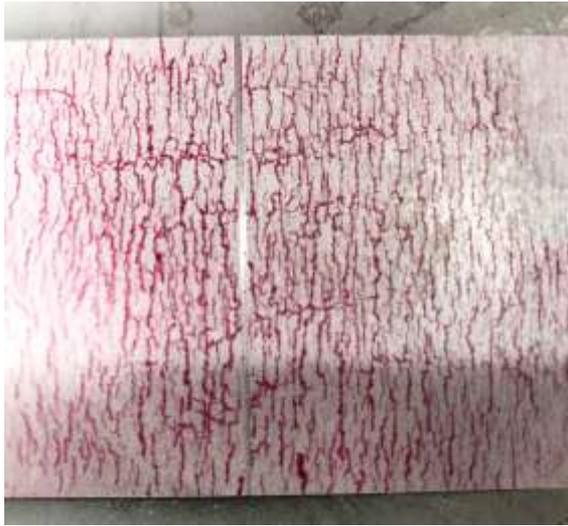
6.15 Developer performance

When applied according to the manufacturer's recommendations, the developer shall give a fine, even, non-reflective and non-fluorescent coating. When used in conjunction with the appropriate penetrant, the developer shall increase the visibility of the penetrant indications.



Red Liquid Penetrant indications on test block

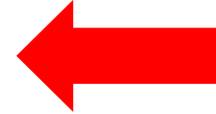
Stable and reliable indications' sizing over time at any temperature



Penetrant «A»

Left: 10 s after application

Right: 3 min after application



Competitor equivalent «B»

Left: 10 s after application

Right: 3 min after application



Too much bleed out =
generation of false cracks +
missing small ones

Magnetic Particles used at high temperatures

Dry and wet solutions for magnetic particle testing at high temp

- Temperature strongly affects liquid penetrants and magnetic particles NDT
- New formulations allow for a safer testing also under extreme conditions and a higher stability of results in a large temperature range (very high and very low temperatures)

Colours available: **RED**, **YELLOW**, **GRAY**, **BLUE**, **BLACK**
Up to + 600 °C

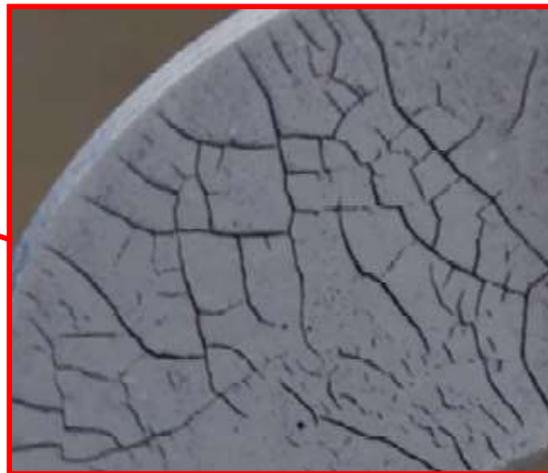
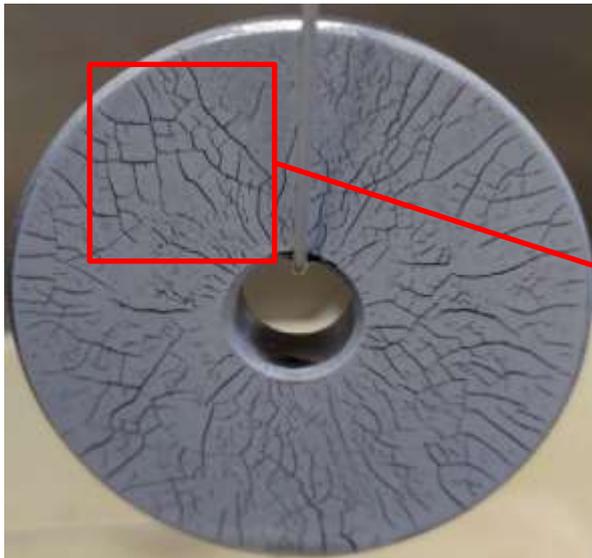


Cracks on pipe shown at +120°C (+248°F) with dual-response fluorescent magnetic powder Elite FW1AC concentrate for water dilution

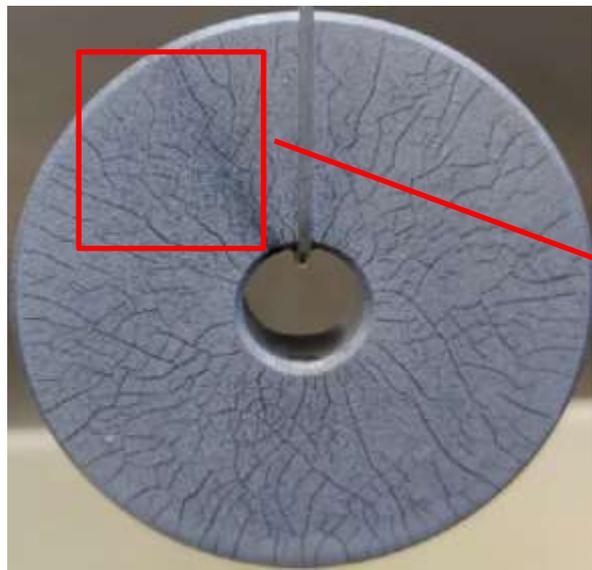
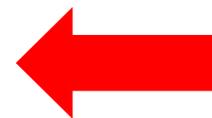


EN ISO 9934-2 temperature resistance test

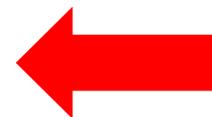
Sharp Black indications and White Contrast easy to remove



Product A at high and low temperatures



Equivalent Magnetic Product «B» at high and low temperatures





ISO 3452-2 Thermal Stability Testing

The Worldwide Standard for Fluorescence Testing – S291

- ASTM E-1135 requires the check of fluorescence for all fluorescent penetrants users and manufacturers
- EN ISO 3452 requires to test the thermal stability of fluorescent brightness: one penetrant must maintain its visibility characteristics even if it is exposed to extreme temperature situation or UV irradiance





Company Case Studies: Safety and productivity innovations

High temperatures in PT, MT, UT

- Temperature strongly affects liquid penetrants, magnetic particles and ultrasonic testing
- New formulations allow for a safer testing also under extreme conditions and a higher stability of results in a large temperature range (very high and very low temperatures)

Elite K71B2p red liquid penetrant used at high temperatures



Cracks on pipe shown at +120°C (+248°F) with dual-response fluorescent magnetic powder Elite FW1AC concentrate for water dilution



Company Case Studies

Liquid Penetrants: high temperatures procedure

UNI EN ISO 3452-5

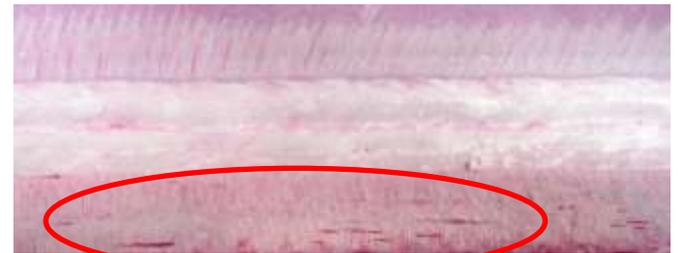
1. Apply red penetrant K71HT on hot welding
 - Tested up to 220° C
 - The only high temperature penetrant available also in spray
 - Very short penetration time
 - Remove excess penetrant according to manufacturer's recommendations (Elite RHT1)



2. Apply white developer Elite D200
 - Tested up to 220° C
 - The only high temperature developer available in spray
 - Developing times are greatly reduced at high temperatures



3. Inspection
 - Inspect under light conditions according to ISO 3059
 - Indications will appear almost immediately



Eni: case study of application of Elite K71B2p at high temperatures offshore

Offshore Application - AST (2G Position)



Eni: case study of application of Elite K71B2p at high temperatures offshore

Offshore Application - AST (2G Position)



Eni: case study of application of Elite K71B2p at high temperatures offshore

Offshore Application - Firing Line (5G Position)



Conclusions: Eni case study of application of Elite K71B2p at high temperatures offshore

Cycle Time Comparison Hot Temperature vs Standard Temperature

ATTIVITÀ	K71B2p + D112A + BC1	K71HT + D200 + RHT1
Pre-Inspection Cleaning	15"	15"
Warming up to 90°C÷110°C	120"	NA
Penetrant application	20"	20"
Dwell Time	30"	420"
Cleaning	20"	20"
Developing	30"	300"
Inspection	20"	20"
Post-Inspection Cleaning	15"	15"
Cooling	60"	NA
Total Cycle Time	330" = 5' 30"	810" = 13' 30"
Δ (Cycle Time)	480" = 8'	

Ultrasonic testing at high or low temperatures

Company Case Study – Ultrasonic Inspection



Couplant specific for Ultrasonic Testing

- ✓ Safe for operator and environment
- ✓ Fast to apply and remove
- ✓ Anti-rust protection
- ✓ Higher quality of the signal (lower background noise): up to +30%



Couplant not specific for Ultrasonic Testing (example: glue, grease, oil...)

- ✗ No Safety Data Sheet or Certificate of Analysis
- ✗ Difficult to prepare (see above) and remove
- ✗ Probe and piece not protected
- ✗ Lower quality of the signal force the operator to increase the gain with higher background noise



Ultrasonic testing at high or low temperatures

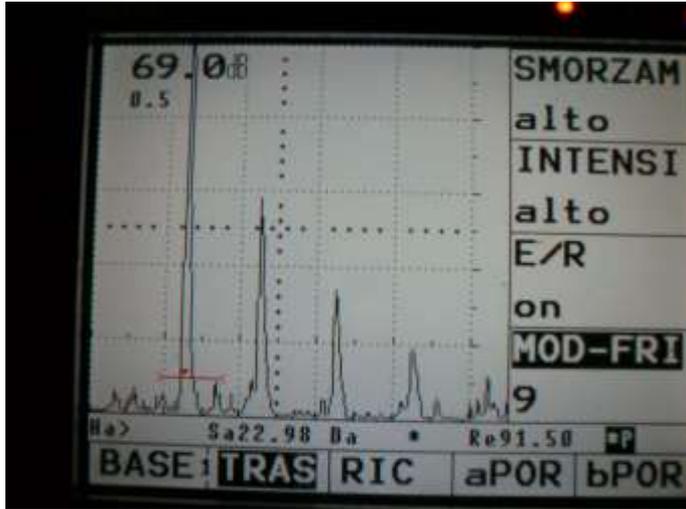
Company Case Study – Ultrasonic Inspection

- UT couplants line up to 520 °C
 - Matrix couplants allows to gain as much as 5 dB compared to water or glue on circular surfaces (pipes) with flat wedges and irregular surface
 - Matrix performs a lot better on high frequencies (10 Mhz)
 - Matrix remains a soft gel usable for a very long time (weeks) without the need to re-apply



Ultrasonic testing at high or low temperatures

Real temperature ranges and operative performances



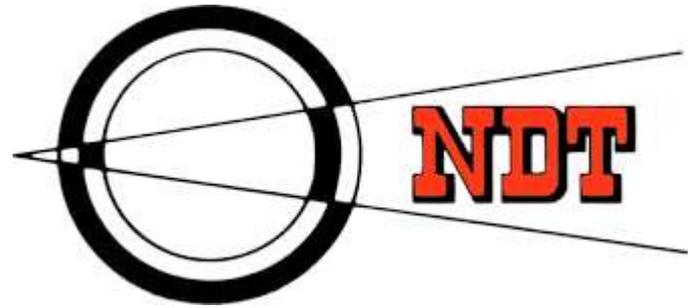
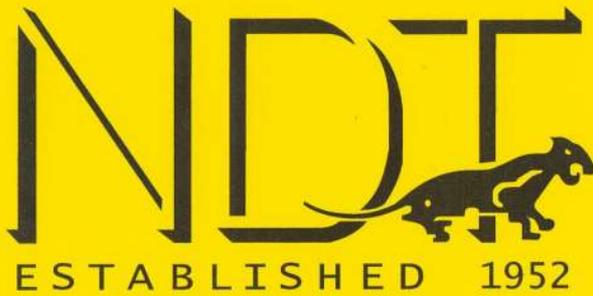
Specific UT High Temp Couplant (e.g. Elite MHT, UHT, C200)

- ✓ Optimal signal intensity
- ✓ No harmful smoke
- ✓ Easy post examination cleaning of probe and piece
- ✓ Certificated from -50°C up to +520°C



Un-specific UT High Temp Couplant (e.g. grease, oils)

- ✗ Significantly lower signal intensity
- ✗ High smoking potentially harmful
- ✗ «Frying» and dripping leaving residues on probe and piece very hard to clean
- ✗ No tested temperature range



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Michele Cevenini

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NDT ITALIANA Proudly Supports Beat Leukemia Foundation

www.beat-leukemia.org

"The difference between difficult and impossible is that impossible takes longer.

Miracles just require faith"