APPLIED ULTRASONICS

ULTRASONIC IMPACT TECHNOLOGY (UIT)

Bringing innovation | Building reliability | Extending asset life

ABOUT APPLIED ULTRASONICS

- OUR STORY | 50 YEARS OF EVOLUTION
- WHO ARE WE | A SNAPSHOT
- OUR GLOBAL FOOTPRINT

OUR STORY

50 Years of Evolution

1

1972

Ultrasonic Impact Technology (UIT) was developed by Scientists and Engineers in Russia for the purpose of strengthening the hulls of their nuclear submarine fleet.

2

1997

Applied Ultrasonics was founded by a small group of industrial professionals with expertise in steel, engineering and manufacturing.

3

LATE 90'S

UIT was subjected to extensive independent testing and verification by a range of highly respected research groups.

4

2002

Applied Ultrasonics commenced the use of UIT for commercial and operational applications globally.

5

2015

Applied Ultrasonics was acquired by Progress Rail a Caterpillar company, who at the time were a large user of the technology globally.

6

2022

Applied Ultrasonics was acquired from Progress Rail by an Australian/US management group and a new manufacturing facility was opened in Alabama, US to support global expansion.

7

2023 & Beyond

Applied Ultrasonics will be looking to expand its specialised offerings within Australia, the US and internationally using the existing service support model and preferred partner program.

THE FUTURE: Key innovation changes will include but not limited to increasing availability of our robotics/automation technology, the use of specialised tools for specific applications and bespoke engineering solutions to allow the assets treated to run harder for longer.

WHO ARE WE?

A Snapshot

Applied Ultrasonics seeks to bring automated or mobile technology to industry, to provide a mechanical fatigue life improvement solution for new/ageing metal structures.

20

YEARS OPERATING INTERNATIONALLY

14

YEARS OPERATING IN AUSTRALIA

INNOVATION MEETS INDUSTRY

Can be applied to most types of metal structures

Technology is mobile and can be setup and used by one person

Has a range of different head solutions to treat just about any scenario

In repetitive applications robots are being used to reduce the cost of labour and improve productivity

THE COMPETITIVE EDGE IN CHALLENGING MARKET CONDITIONS

Cost effective to apply compared with other techniques

Provides a more efficient repair process when compared to traditional post-weld treatments

Provides up to 4 x the life extension to repaired welds vs. no application

A competent non-tradesperson can be trained and certified

PURSUING GLOBAL SUSTAINABILTY AND ETHICAL PROGRESS

Helping older structures last longer, delaying the need to rebuild or go new

No direct emissions and low power consumption

Supporting the generation for change in International Welding Standards

Developing new technology to offer repair solutions for the renewable energy industry

A TAILORED APPROACH TO PARTNERSHIP

Collaborate on new methods of repair

Work collaboratively on research and development for better solutions

Offer options on how to access the technology

Provide the process, training and engineering to educate

Honour the right values

OUR GLOBAL FOOTPRINT

HEADQUARTERS IN NEWCASTLE, AUSTRALIA AND ALABAMA, UNITED STATES OF AMERICA

CUSTOMERS IN 13 COUNTRIES

Australia | USA | Europe | UAE | India | Singapore | South Korea | Japan | Columbia | Mexico | Canada | South Africa | United Kingdom

WHY APPLIED ULTRASONICS?

- WHAT INDUSTRIES DO WE SERVICE?
- KEY APPLICATIONS OF THE TECHNOLOGY
- OUR OFFERING
- HOW CAN UIT DELIVER SUCCESS FOR MY ORGANISATION?
- WHAT ARE THE KEY ADVANTAGES OF THIS TECHNOLOGY?
- OUR COMMITMENT TO SAFETY

APPLYING UIT ACROSS INDUSTRIES

REFINERIES

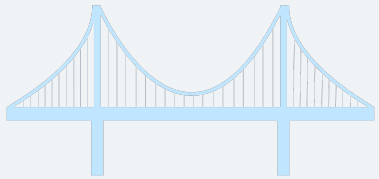
- Tanks
- Pipework

MINING

- Buckets
- Chassis
- Draglines

RAIL

- Engine blocks
- Chassis
- Wagons
- Rail tracks



STRUCTURES

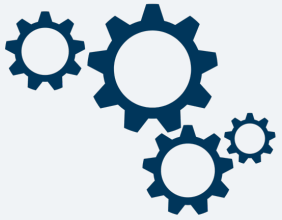
- Bridges
- Fixed plant
- Power station turbine fans

OIL & GAS

- Valves
- Pipes
- Structures

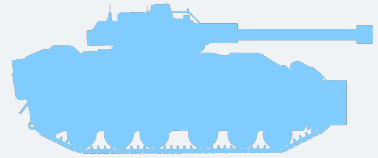
RENEWABLES

- Windfarm turbines
- Hydro facilities



MANUFACTURING & PROCESS EQUI0PMENT

- Robotics
- Crankshafts
- Gears
- Bearings



MILITARY & AEROSPACE

- Armoured vehicles
- Air frames
- Navy vessels

KEY APPLICATIONS

STRESS CORROSION CRACKING (SCC)

UIT can be used to mitigate the effects of Stress Corrosion Cracking (SCC). The UIT process can be used on most materials susceptible to SCC to minimize and/or arrest the propagation of SCC.

DISTORTION MITIGATION

When UIT is applied to welded surfaces, it neutralizes the tensile stress created during welding and relaxes the welded structure reducing and or eliminating distortion.

FATIGUE LIFE IMPROVEMENT

Upon application of UIT to the weld toe, the weld toe geometry is modified creating a fatigue friendly geometry. Compressive residual stress is imparted into the heat affective zone (HAZ) improving grain structure and strength.

A TAILORED OFFERING

Applied Ultrasonics offers a range of engagement models, so we can tailor our partnership according to the needs of your business, your budget, project goals, in-house resources and timeline

- PROJECT-BASED MACHINE & LABOUR SUPPLY
- MACHINE LEASING
- PLANNING & EXECUTION OF LARGE AND SMALL JOBS
- COLLABORATIVE INNOVATION INCLUDING THE USE OF ROBOTICS
- EQUIPMENT SALES
- UIT TRAINING & ENGINEERING SUPPORT
- PROJECT CONSULTING
- RESEARCH, DEVELOPMENT & AUTOMATION

HOW CAN UIT DELIVER

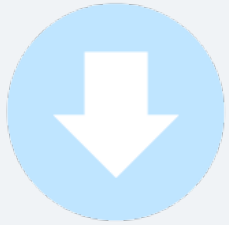
SUCCESS FOR OUR ORGANISATION?

EXTENDED LIFE

UIT has proven to be able to extend the fatigue life of welded structures, allowing extended replacement intervals providing asset owners alternatives to replacement. By doing this owners can conserve capital, redeploy at opportune times and reduce the risks of failure.

UIT can be applied in the OEM or repair phase and the treatment can be carried out at the manufacturing site, in the parts supplier workshop, or as repairs at a fixed site or in the field.

DECREASED DOWNTIME



Having the ability to stress relieve as you repair guarantees a better service life, reducing the likelihood of having unplanned failures in the same area in the future. Less intervention means better uptime and resources to focus on other parts of the structure through the asset's lifecycle.

Time is money and UIT's proven ability to achieve x 4 times the life extension of welds means fewer repairs resulting in assets not needing to come out of production or go offline as frequent.

IMPROVED RELIABILITY

Mean time between failure and mean time to repair are key drivers of asset availability. As such, having the ability to repair and forget as well as not adding to repair time itself provides huge opportunities for the owner.

Your investment in UIT provides you with the confidence that when you carry out weld repairs and treat them with UIT that they will last enabling your equipment's productivity to increase.

REDUCED COSTS

Key areas to save with UIT:

- Extended repair life
- Less intervention post repair
- Mobile tech allowing for field repairs meaning the item may not have to removed to be repaired

The use of UIT over time on the same assets, such as annual shutdowns has been proven to show a significant cost reduction in the number of weld repairs required to maintain that asset.

ZERO HARM ALIGNED

Using uncontrolled Pneumatic peening tooling puts stress on the operator over time and can lead to strain injuries. Having access to a tool that provides a safer operator experience and a more consistent application reduces companies risk and ultimately provides a better outcome

UIT has significant WHS advantages versus other forms of mechanical peening. The equipment emits minimal noise, has low vibration and is lightweight. Our operational procedures ensure a safety-focused approach to every job.

ENVIRONMENTAL SUSTAINABILITY

Key benefits with UIT:

- Supports the reduction of waste by helping older assets run longer
- Low cardon footprint
- Low energy usage
- All components can be recycled

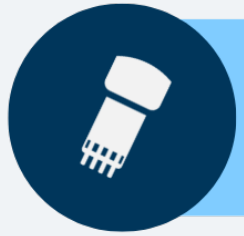
It's everyone's Corporate Social Responsibility to commit to more environmentally sustainable practices where we can. UIT supports sustainability through its efficiency in application and asset life extension.

KEY ADVANTAGES OF UIT

MOBILE/LIGHTWEIGHT EQUIPMENT
Easily transportable for use in the field and the workshop

OPERATIONAL PROCESS
UIT can be operated by personnel who are trained and certified – not exclusive to tradespeople

QUALITY ASSURANCE REPORTS
The technology generates it's own quality reports, streamlining access to relevant performance data and providing a QA step that other technology can't



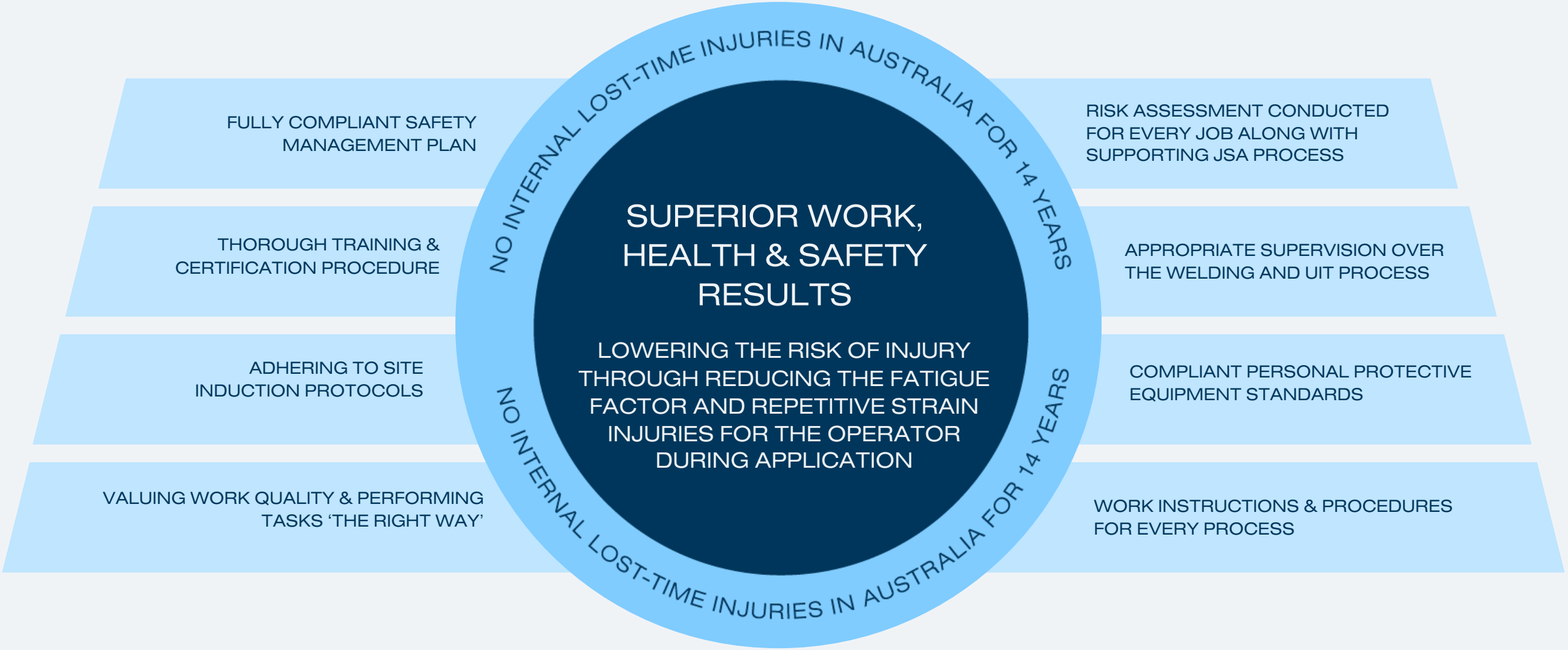
INTERCHANGEABLE TOOL HEADS
A range of tool heads are available for different applications

VERSATILITY ACROSS MATERIALS
UIT is suitable for use across a wide range of metal structures and settings are adjustable depending on the material type

AUTOMATION
UIT has effectively treated materials using robots and is driving innovation with cutting-edge technologies

OUR COMMITMENT TO SAFETY

We pride ourselves on our safety record and the fact all the UIT hours in that 14 years of operation have been done in client facilities. Now having the ability to be able to offer this superior technology to our clients will only further help reduce the injury risks for their teams and that of their contractors for what is seen in many organisations as a daily task.



THE PROCESS

- AN OVERVIEW OF THE TECHNOLOGY & TOOLING
- HOW UIT WORKS | RESIDUAL COMPRESSIVE STRESS & GRAIN REFINEMENT
- MISCONCEPTIONS AND IMPORTANT FACTS

THE TECHNOLOGY

An Overview

- UIT uses an electromechanical process converting ultrasonic energy into mechanical energy
- When applied to metal/fabricated structures, the process imparts residual compressive stresses, mitigating harmful tensile stress as well as modifying the grain structure

Feature Fundamentals

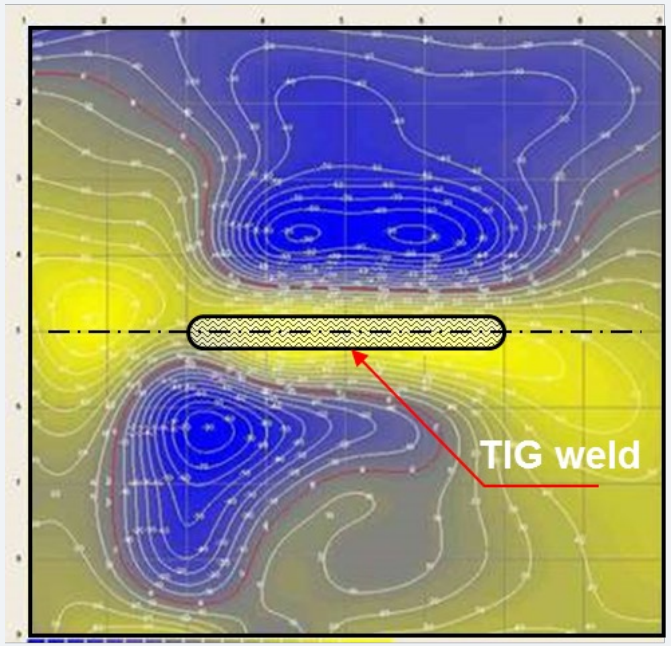
ULTRASONICS	MECHANICAL ENERGY	ENERGY TRANSFER TO METAL
Operates at greater than 25kHz	Offers adjustable amplitude	Free-floating indenters permit the movement of the ultrasonic tool across the surface being treated

THE TOOLING

HOW UIT WORKS

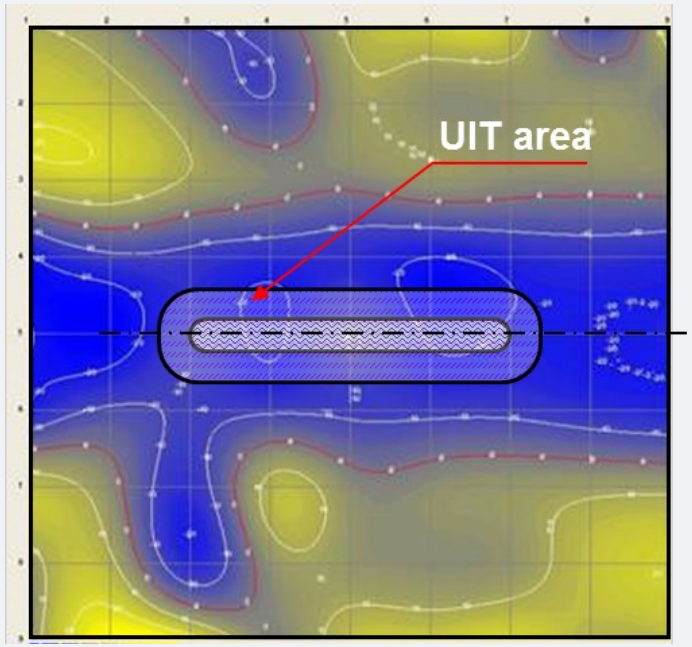
RESIDUAL COMPRESSIVE STRESSES

BEFORE UIT – CHART 1



Stress chart for a steel specimen after argon-arc welding

AFTER UIT – CHART 2



Stress chart for a steel specimen after ultrasonic impact treatment of the welding area

COMPRESSIVE STRESS

TENSILE STRESS

CHART 1:

- Undesirable tensile stresses (yellow) are introduced throughout the manufacturing process and repairs (i.e. forming, welding, machining and cutting).

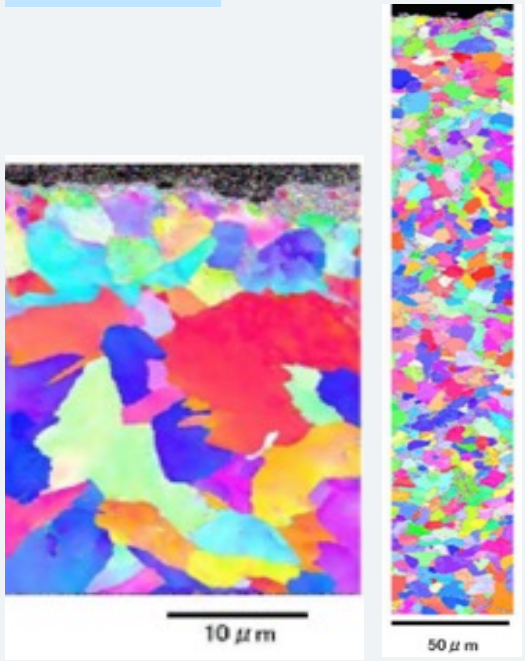
CHART 2:

- UIT eliminates detrimental tensile (+) stresses
- UIT imparts beneficial compressive (-) stresses (blue) in fabricated and machined components.

HOW UIT WORKS

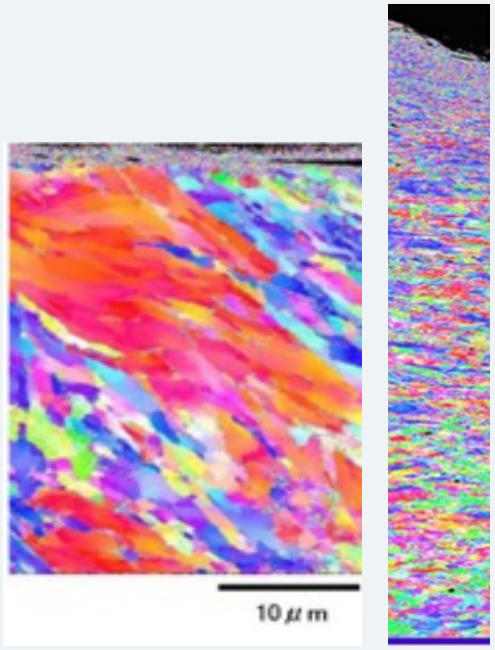
GRAIN REFINEMENT

BEFORE UIT



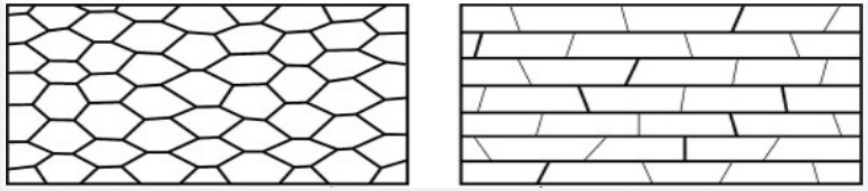
GRAIN SIZE: HOMOGENOUS (ABOUT 10 μ m)
GRAIN ORIENTATION: RANDOM

AFTER UIT



GRAIN SIZE: ULTRAFINE IN SURFACE REGION (ABOUT 0.5 μ m)
GRAIN ORIENTATION: LAYERED

BEFORE UIT **AFTER UIT**



PICTURED ABOVE: GRAIN ELONGATION

IT'S IMPORTANT TO NOTE

- UIT does not work on vibration – it uses ultrasonics; the most advanced technology available
- UIT will not fix an unsatisfactory welding process
- UIT will not work if it is not applied using the correct process, by a trained Operator
- Contrary to full heat treatment or vibration techniques, UIT treats the area, not the entire structure

OUR NETWORK

- CUSTOMERS CAPITALISING ON UIT'S INNOVATION

SOME OF THE ORGANISATIONS WHO ARE

CAPITALISING ON UIT INNOVATION

THE FUTURE

- WHAT'S NEXT FOR APPLIED ULTRASONICS?

IN SUMMARY

In the face of rising input costs to manufacture and repair, labour shortages and the need to push assets harder for longer, UIT is seen as an industry enabler to do this while managing key operational risks.

In light of this, Applied Ultrasonics will continue to work with its' clients, industry Subject Matter Experts and Standards committees to develop the UIT technology and make it increasingly accessible for more users.

There are 4 key areas of focus for Applied Ultrasonics:

Robotics and Automation

Bringing our robots to market to address labour constraints and solve repeatable problems

UIT Tools

Adding to our extensive range of bespoke applicators and machine types to be able to treat more areas more effectively

Research and Development

Further build on our testing to expand the treatable material range and further improve on UIT performance

Service Offering

Continue to build out our service offering and partners to cover more locations globally and provide further in house expertise to support clients

For more information, please contact Applied Ultrasonics | www.appliedultrasonics.com

Jason Hoogerwerf | 0422 058 650

Phil Ayre | 0429 553 950

APPENDIX

- UIT MEETING INDUSTRY STANDARDS
- UIT APPLICATIONS & PROJECT EXAMPLES

MEETING INDUSTRY STANDARDS

RECOGNISED BY WELD AUSTRALIA

Weld Australia

AUSTRALIA STANDARD 1210

STANDARDS Australia

US ENDORSEMENTS

LLOYD'S

ABS

AWS American Welding Society

American Association of State Highway and Transportation Officials AASHTO

DNV·GL

UIT APPLICATIONS

DIPPER & DRAGLINE BUCKETS

- Crack repairs
- Linkage repair/replacement
- Teeth
- Adapters
- Distortion control

PROJECT EXAMPLES




UIT APPLICATIONS

DRAGLINE PROPEL STRUCTURE REPAIR

- UIT utilised on propel structure (weld cracking)
- Prior to UIT there were unplanned maintenance events every 6 months
- 5 years after UIT application there were zero cracks
- Comparison was conducted on propel weld joints treated with and without UIT, non-UIT joints failed within 6 months – driving the use of UIT on all critical weld joints

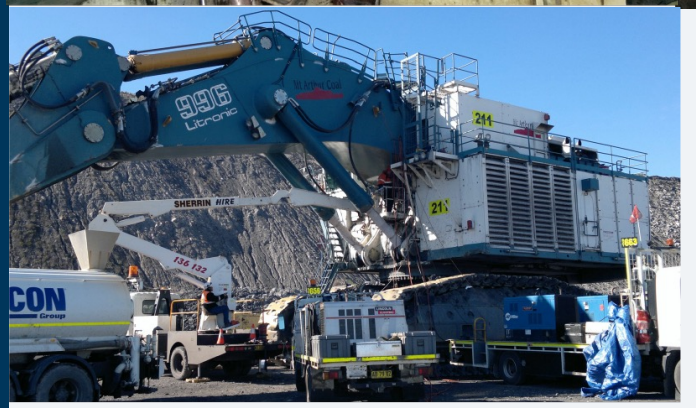
PROJECT EXAMPLES

UIT APPLICATIONS

EXCAVATOR BOOM FIELD REPAIR

- Boom crack repaired in the field minimizing downtime
- UIT was used to treat critical structural welds

PROJECT EXAMPLES



UIT APPLICATIONS

DUMP TRUCK BEDS

- Truck body frame rail welds consistently cracking
- Welds excavated, replaced and UIT used to treat new welds
- Cracks never reappeared

PROJECT EXAMPLES

UIT APPLICATIONS

KDOT Bridge

- Engineer's estimate: $32.7m to replace superstructure
- UIT incorporated into the welding procedure
- Reduced retrofit cost from $32.7M to $11.6M (saving over $20M)
- UIT is endorsed by the American Association of State Highway and Transportation Officials (AASHTO)

PROJECT EXAMPLES

UIT APPLICATIONS

RING GEAR

- 12 foot diameter Ring Gear developed a through crack at bolted connection
- Standard weld repairs not viable, distortion would render gear inoperable
- UIT employed, treating each weld layer to mitigate distortion
- 100% success – final measurements within tolerance, gear true and round

PROJECT EXAMPLES

UIT APPLICATIONS

CRUSHER ROLL

- Fatigue hard-facing/base metal interface cracking resulting in separation of large sections
- UIT performed after build-up of base metal and machining
- Compressive residual stress reduced tensile stresses at interface
- 3 x life extension

PROJECT EXAMPLES

UIT APPLICATIONS

ROTARY KILN

- Kiln consistently cracking at circumferential welds near bearing pads
- UIT process applied to weld layers, cap and toes
- Cracking yet to reoccur in UIT treated regions

PROJECT EXAMPLES

UIT APPLICATIONS

DEBARKER SHAFT

- Poor service life – fails within 2 months at shaft transition resulting in unscheduled outages and lost production
- UIT used to treat shaft at transition
- Shaft survival rate increased by 3 times

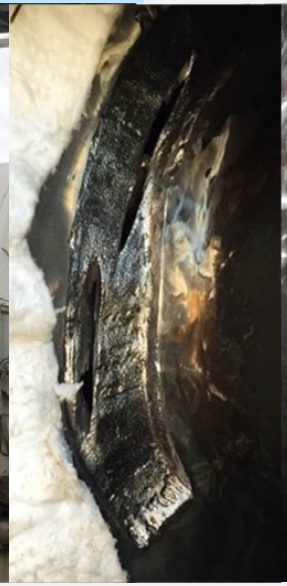
PROJECT EXAMPLES

UIT APPLICATIONS

FOOD PROCESSING PLANT

- Cracking present in pressure vessel head at shaft penetration
- UIT prevented reoccurrence

PROJECT EXAMPLES



UIT APPLICATIONS

US NAVY

- Stress Corrosion Cracking (SCC) present, standard weld repairs failing prematurely and weld repairs resulting in additional cracking
- UIT implemented pre/during/post welding on USS Cape St. George
- Result was zero cracks present on USS Cape St. George, UIT performed on 20+ CG class ships and zero cracking present in UIT treated areas
- US Navy expanded UIT use to LCS and EPF class ships
- Cost avoidance in $M

PROJECT EXAMPLES

UIT APPLICATIONS

CRANKSHAFTS

- Substandard service life of crankshafts
- UIT used in place of existing process (shot peening) which resulted in residual compressive stresses 4 x deeper than shot peening and 5 x life improvement
- Manufacturing lines were converted to UIT

PROJECT EXAMPLES

UIT APPLICATIONS

RAIL

- Locomotive treatments: frames, exhaust ports, freight/tank cars
- Infrastructure treatments: Class I RR, Shortline RR, 1890 Bridge

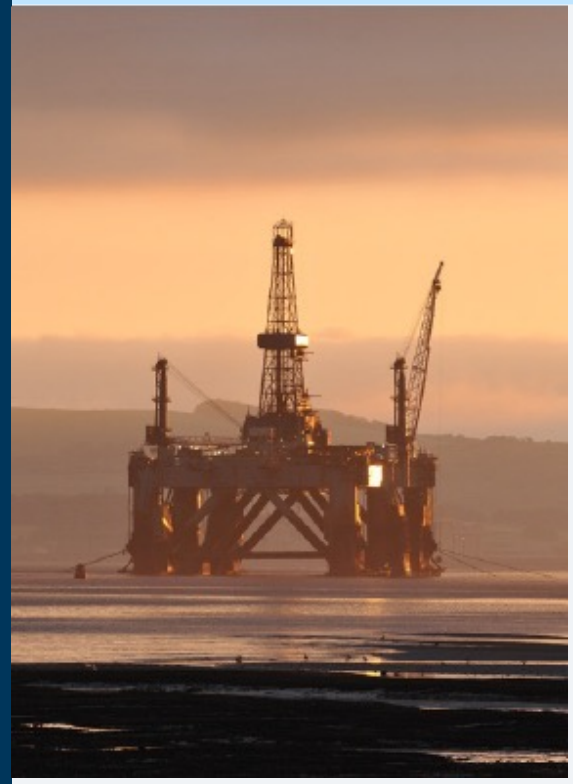
PROJECT EXAMPLES

PROJECT EXAMPLES

UIT APPLICATIONS

SEMI-SUBMERSIBLES (NOBLE DRILLING)

- UIT incorporated into the welding procedure
- Fatigue life extended 8-fold
- 15 year life extension granted by certifying body American Bureau of Shipping (ABS)



UIT APPLICATIONS

TRANSOCEAN DERRICK GUSSETS

- Deepwater Pathfinder – cracking in derrick base
- UIT incorporated into welding procedure
- Fatigue life extension through introduction of residual compressive stress

PROJECT EXAMPLES

UIT APPLICATIONS

AEROSPACE ORION PROGRAM

- Critical Friction Stir Welds (FSW) joining sections of aluminium
- Use of UIT mitigated distortion and enabled FSW to meet design tolerance

PROJECT EXAMPLES

UIT APPLICATIONS

DIPPER HANDLE PYRAMID

- Large (6ft) crack located in Pyramid area of Dipper Handle casting, required downtime every 3 weeks to repair crack
- UIT used to treat each weld layer
- UIT repair lasted 26 weeks until the replacement part was available
- 8 x life extension

PROJECT EXAMPLES

UNPLANNED OUTAGE DIPPER HANDLE REPAIR COST BENEFIT

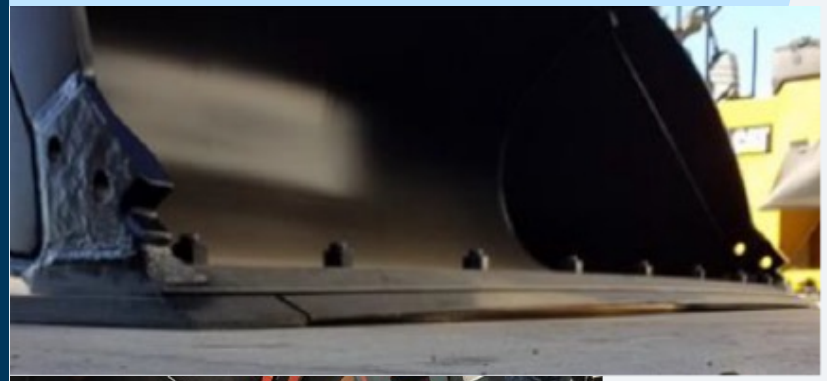
DESCRIPTION	KEY FIGURES
Repair frequency	21 days
Repair duration	2 days
Hours of operation per day	20 hours
Hours of lost operation per repair	40 hours
Projected shovel gross revenue per hour	$40K
Shovel production gross revenue lost per repair	$1.6M
Repair cycles eliminated per annum using UIT	8
Cost benefit per annum of using UIT	$12.8M

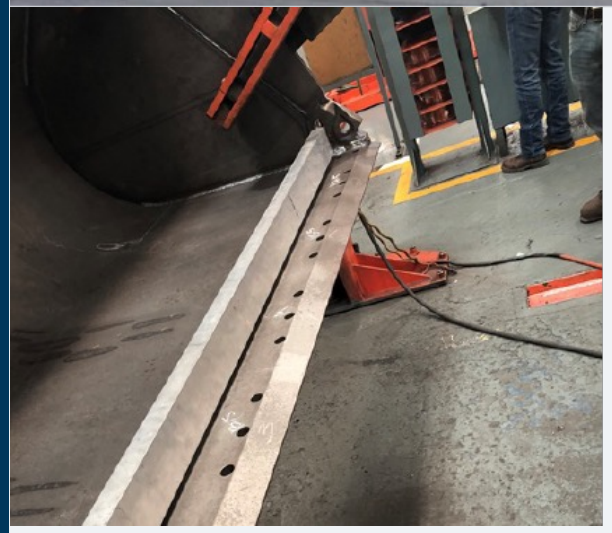
UIT APPLICATIONS

CAT MWL BUCKET DISTORTION

- Bottom bucket edge bows during fabrication processes, creating either a concave or convex bucket edge
- Bucket placed in press to bend edge to an intolerance position
- Targeted UIT application controls distortion bucket and when used in conjunction with welding results in producing an intolerance bucket

PROJECT EXAMPLES



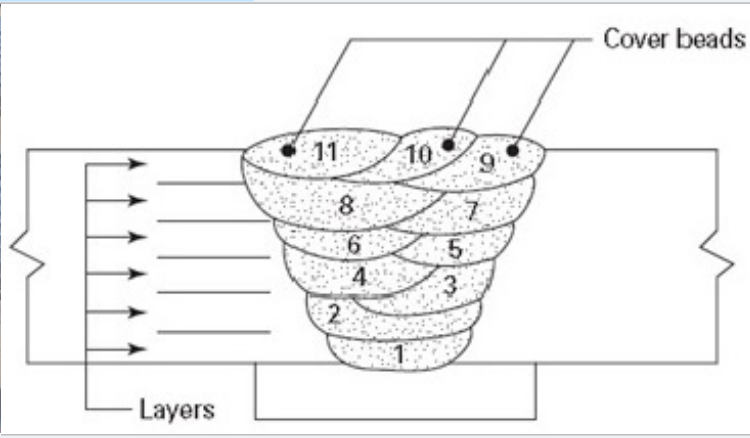


UIT APPLICATIONS

CAT 793D

- Cracking prevalent at 750 hour inspection interval with conventional FCAW weld repairs typically performed
- UIT process integrated with existing Cerrejon weld procedure extending prevalent cracking from 750 hours to 6,000+ hours
- UIT process included treatment of each weld layer, cover beads ground flush, final UIT treatment of ground cover beads and HAZ

PROJECT EXAMPLES

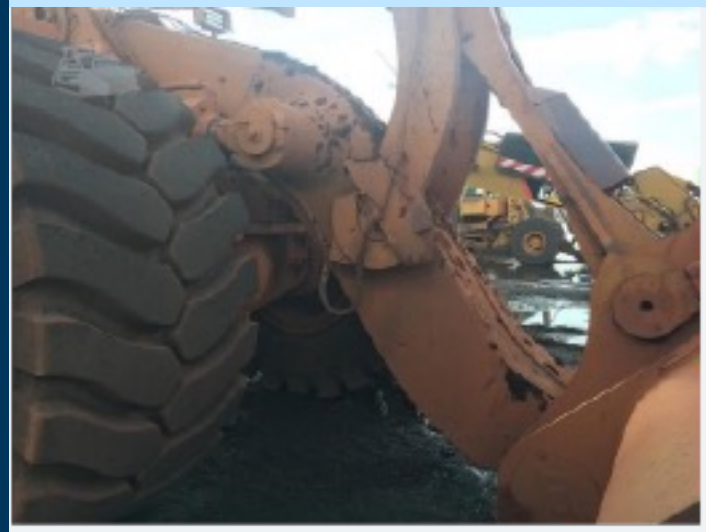


UIT APPLICATIONS

CAT 992G BOOM ARM CRACK

- Crack noticed during normal PM and treated wit UIT
- Residual compressive stresses imparted resulting in no further growth of the crack allowing maintenance to schedule the repair at a convenient time

PROJECT EXAMPLES



UIT APPLICATIONS

CAT 793D HORSE COLLAR REPAIR

- UIT pre-treatment to control crack growth
- UIT repair completed with residual compressive stresses imparted to the treated area

PROJECT EXAMPLES

UIT APPLICATIONS

CAT D11R SIDE FRAME

- D10 and D11 side frames internal and external cracking required weld repair
- UIT was applied to the crack prior to air arc gouging, limiting the growth of the crack
- UIT process involved treatment of each weld layer, cover beads ground flush and final UIT treatment of ground cover beads and HAZ

PROJECT EXAMPLES