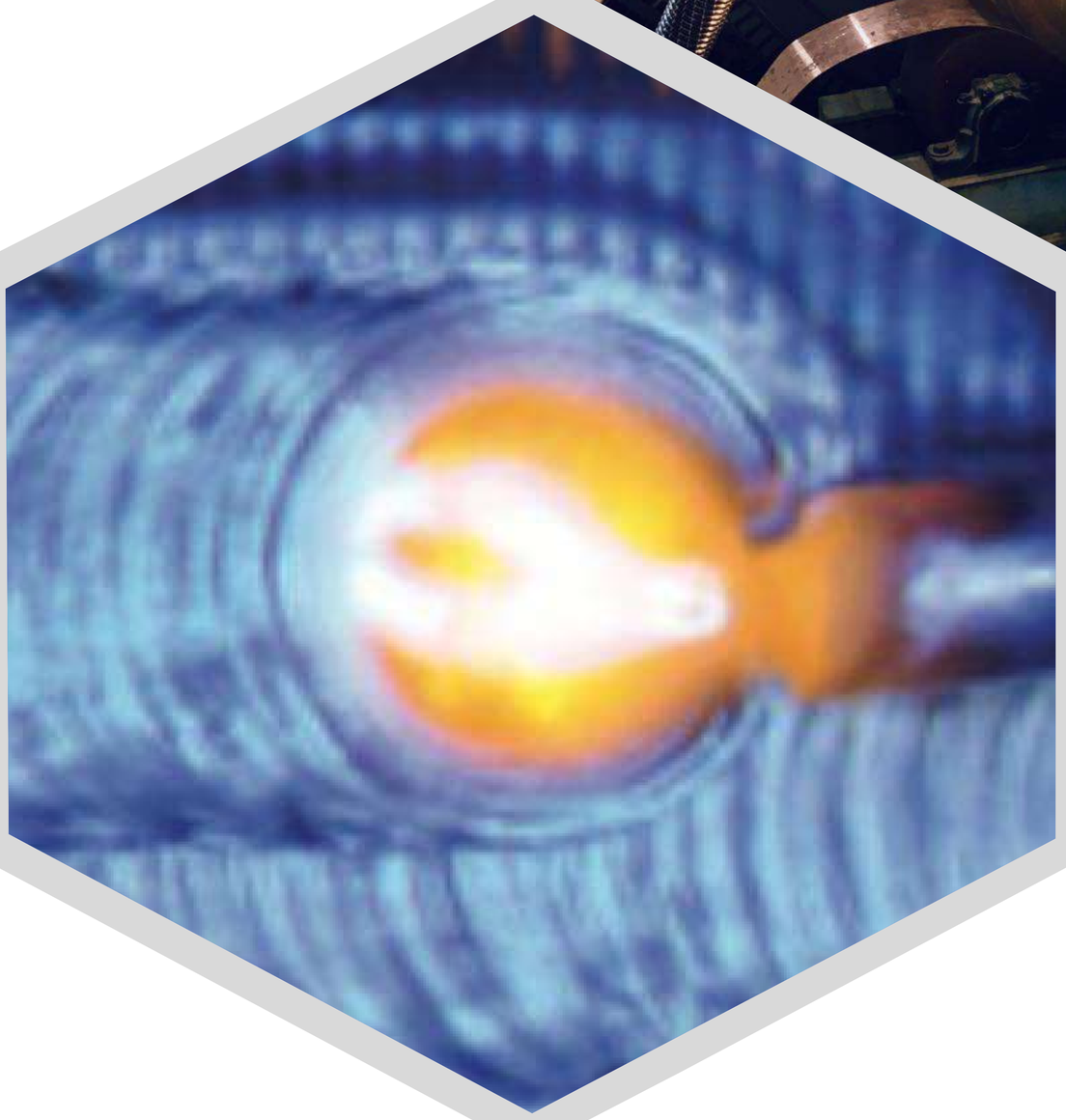
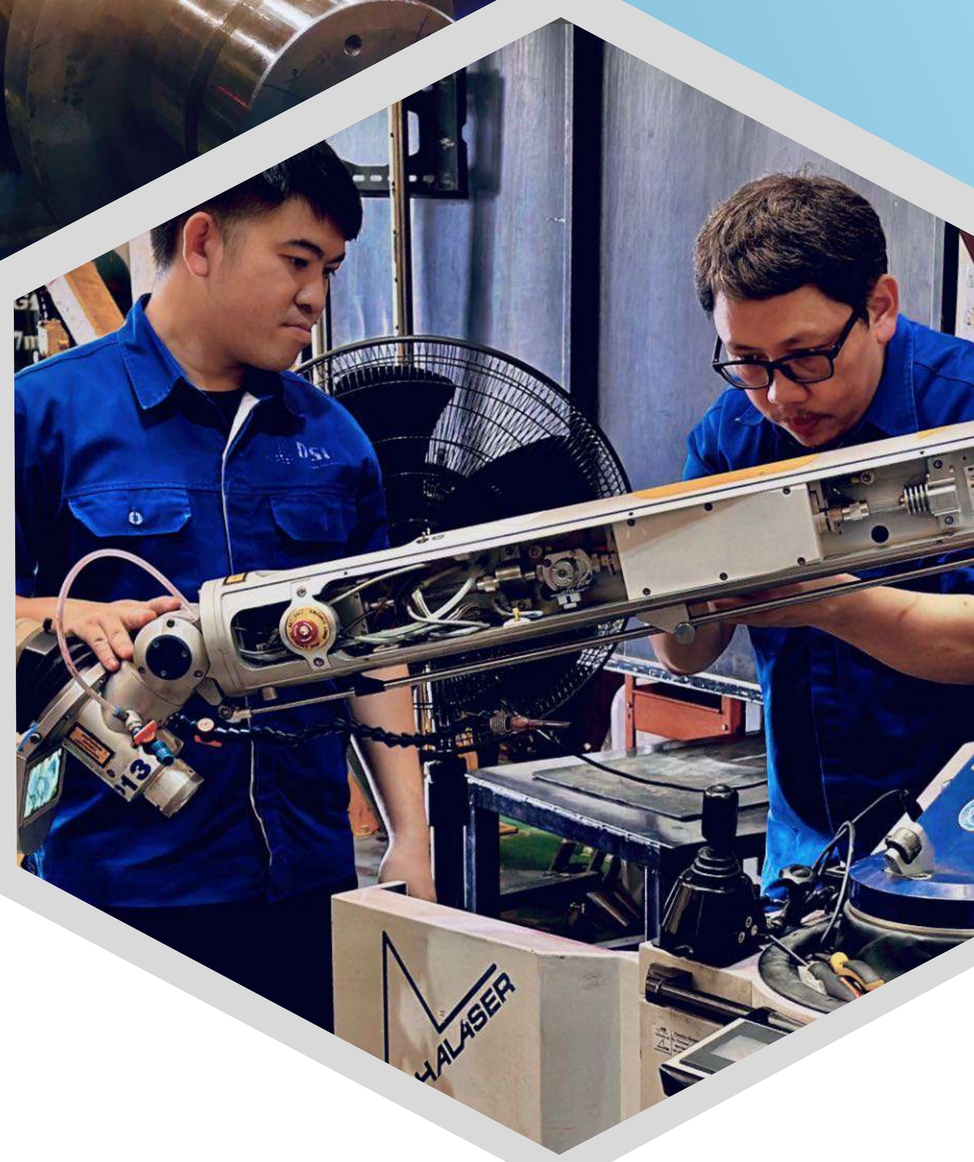
DSI

PULSE LASER WELDING







PULSE LASER WELDING
HANDBOOK

DSI LASER SERVICE (THAILAND) CO.,LTD.

DSI TOTAL SOLUTION for **PULSE LASER WELDING**
with **DSI LASER WIRES**

dsilaser.com

GERMAN
TECHNOLOGY

DVS ZERT
ISO 3834-2:2021

ALPHALASER
SOUTHEAST ASIA



Legal Notice :
Created and compiled by DSI Thailand Laser-Welding Academy

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Published on behalf of DSI Laser Service (Thailand) CO., LTD and
ALPHA LASER Southeast Asia CO., LTD
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dsilaser.com

DSI
PULSE LASER WELDING

DSI Laser Service (Thailand)

It's all about Pulse Laser Welding

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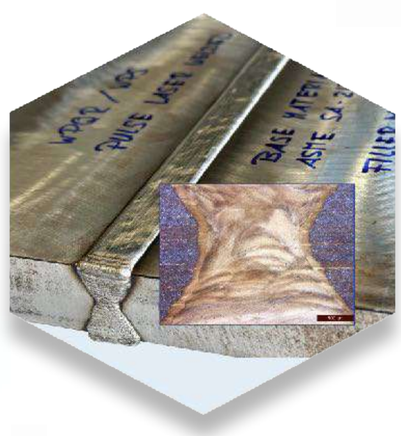
DSI Thailand : History - Milestones	02 - 03
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DSI Laser Service (Thailand)

History & Present

2000 - 2025

Founded in 2000, *DSI Laser Service (Thailand) Co., Ltd.* pioneered Thailand's first professional Pulse Laser Welding Service, initially supporting customers in the Molds & Dies and Automotive sectors. Over the past 25 years of continuous innovation and expertise, *DSI-Thailand* has evolved into a trusted one-stop provider with a core service-concept called :

DSI Total Solution for ***Pulse Laser Welding*** with ***DSI Laser Wires***

Today, *DSI Laser Service (Thailand)* proudly serves customers in any industry :
Dental & Jewelry / Molds & Dies / Automotive / Oil & Gas / Power Generation
Heavy Industry / Marine / Aerospace (MRO).

DSI Total Solution includes :

- ✓ Pulse Laser Welding Service
- ✓ DSI Laser Welding Wires
- ✓ Machine processing / pre- and finishing of surfaces
- ✓ Authorised Dealer of ALPHA LASER Systems
- ✓ Service & Maintenance for ALPHA LASER Systems
- ✓ DSI Thailand Laser-Welding-Academy

DSI Laser Service (Thailand)

Milestones & Quick Facts

DSI Total Solution
for
Pulse Laser Welding
with
DSI Laser Wires

2000
DSI Laser Service (Thailand) Co., Ltd. was founded

2002
Successfully certified :
- ***ISO 3834-2***
- ***ISO 14732-12***

2004
DSI-Thailand became ***authorised dealer*** of ***ALPHA LASER***

2009
PLW-Technology applied to ***Oil & Gas, Petrochemical*** and ***Power Generating*** industry

2010
Developing ***WPQR & WPS*** for PLWelding

2015
DSI Laser Wires program released.
Drawn-Down Process at *DSI-Thailand*

2016
Entered ***Aerospace (MRO)*** Industry Successfully Certified :
- ***AWS C7.4/C7.4M***
- ***AWS D17.1/D.17M***

2017
Foundation of DSI-Thailand partner ***DKN-Japan***

2020
Foundation of ***DSI Thailand Laser-Welding Academy***

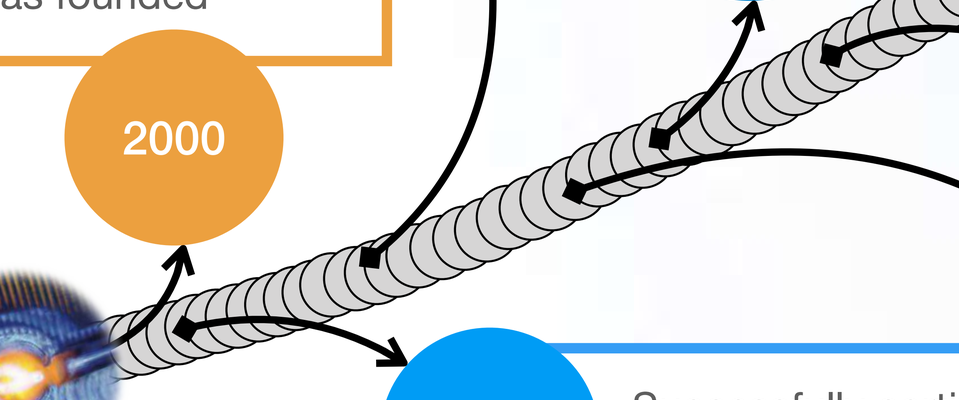
2021
Foundation of ***ALPHA LASER Southeast Asia***

2024
Foundation of ***DSI-Malaysia branch***

AL-2400 F successfully commissioned and implemented for PLW-Service for customers in whole Southeast Asia

Quick Facts

4,200 sqm Workspace



DSI Chonburi : Head Office & Workshop



Phu Mueng : Machine Processing / Workshop 2



46 Employees



19 PLW-Machines

DSI
PULSE LASER WELDING

Pulse Laser Welding

Committed to premium Quality

DSI Laser Service (Thailand) & ***Pulse Laser Welding Technology***

comply the quality requirements certified according to **ISO 3834-2:2021**

DVS ZERT

CERTIFICATE

D-ZE-16083-01-00-ISO3834-2015.0053.006

DVS ZERT hereby certifies that the company

DSI Laser Service Thailand Co. Ltd.
33/1 Moo 5 Tambol Nongmaidang
20000 Chonburi
Thailand

has furnished proof to fulfil
the quality requirements for welding according to

ISO 3834-2:2021

in the extent mentioned on the reverse side.

validity: 25.11.2022 until 16.02.2026

Düsseldorf, 25.11.2022
Place and date of issue

Prof. Dr.-Ing. Kuscher
Lead Assessor

Dipl.-Ing. Gurschke
Head of certification body

DVS ZERT GmbH, Aachener Straße 172, 40223 Düsseldorf, GERMANY

DAkkS Deutsche Akkreditierungsstelle D-ZE-16083-01-00

Pulse Laser Welding

Qualification & Standards

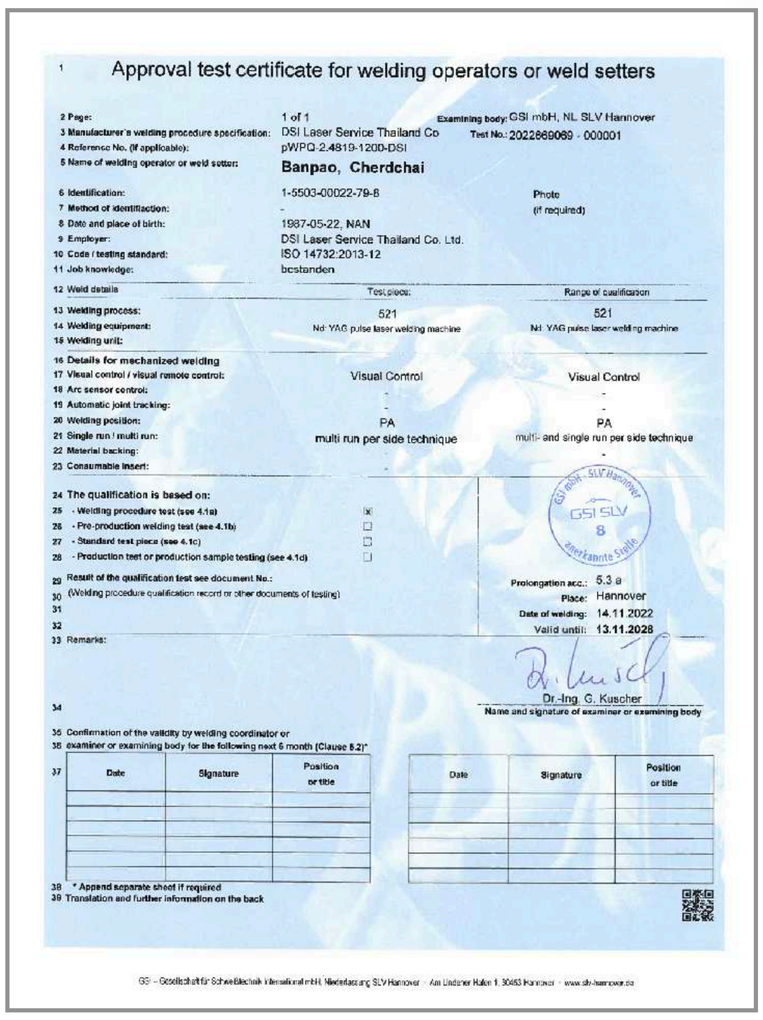
Pulse Laser Welding Technology can follow **any** welding standard and its examinations like ISO, AWS, ASME, JIS, GB/T.

Pulse Laser Welding Processes are specified and qualified by :

- Welding Procedure Qualification Record (WPQR)
- Welding Procedure Specification (WPS)

DSI-Thailand PL-Welders & **PLW-Machine-Operators** are certified according to:

- ISO 14732:2013-12
- AWS D14.6/D14.6M:2012
- AWS D17.1/D17.1M:2017



1 Approval test certificate for welding operators or weld setters

2 Page:	1 of 1	Examining body: GSI mbH, NL SLV Hannover
3 Manufacturer's welding procedure specification:	DSI Laser Service Thailand Co	Test No.: 2022869089 - 000001
4 Reference No. (if applicable):	pWPQ-2.4819-1200-DSI	
5 Name of welding operator or weld setter:	**Banpao, Cherdchai**	
6 Identification:	1-5503-00022-79-8	Photo (if required)
7 Method of identification:	-	
8 Date and place of birth:	1987-05-22, NAN	
9 Employer:	DSI Laser Service Thailand Co. Ltd.	
10 Code / testing standard:	ISO 14732:2013-12	
11 Job knowledge:	bestanden	

12 Weld details	Test piece:	Range of qualification
13 Welding process:	521	521
14 Welding equipment:	Nd:YAG pulse laser welding machine	Nd:YAG pulse laser welding machine
15 Welding unit:		
16 Details for mechanized welding		
17 Visual control / visual remote control:	Visual Control	Visual Control
18 Arc sensor control:	-	-
19 Automatic joint tracking:	-	-
20 Welding position:	PA	PA
21 Single run / multi run:	multi run per side technique	multi- and single run per side technique
22 Material backing:		-
23 Consumable insert:	-	

24 The qualification is based on:

25 - Welding procedure test (see 4.1a)	☒
26 - Pre-production welding test (see 4.1b)	☐
27 - Standard test piece (see 4.1c)	☐
28 - Production test or production sample testing (see 4.1d)	☐

29 Result of the qualification test see document No.:
30 (Welding procedure qualification record or other documents of testing)
31
32

Prolongation acc.: 5.3.a
Place: Hannover
Date of welding: 14.11.2022
Valid until: 13.11.2028

33 Remarks:

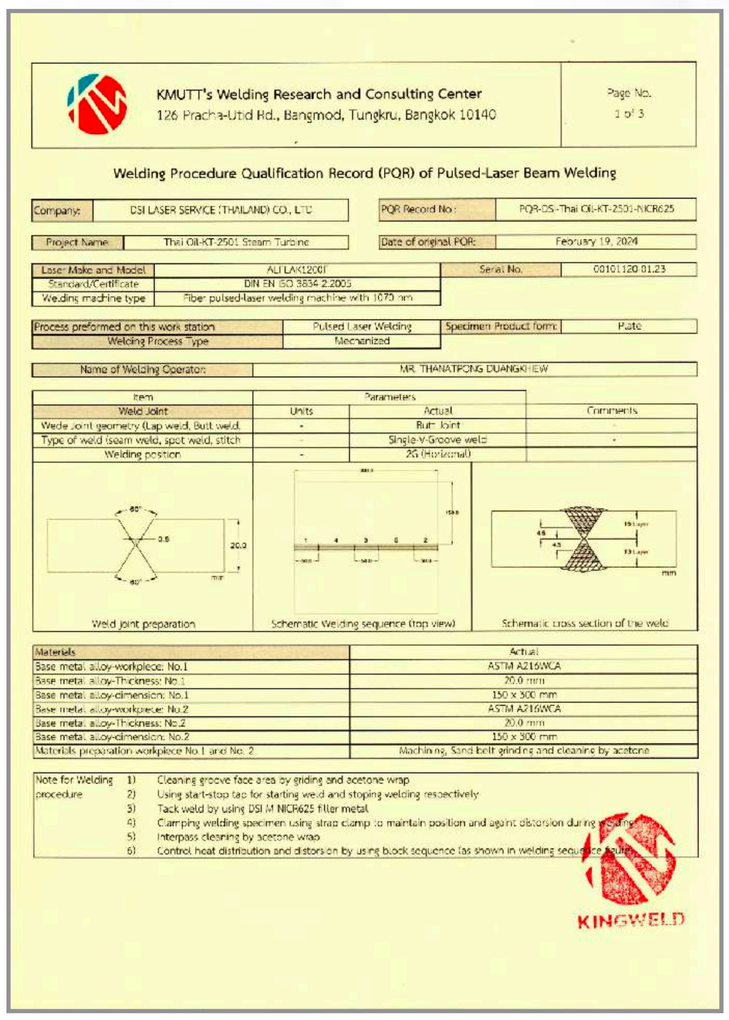
Dr.-Ing. G. Kuscher
34 Name and signature of examiner or examining body

35 Confirmation of the validity by welding coordinator or
36 examiner or examining body for the following next 6 month (Clause 5.2)*

37 Date	Signature	Position or title	Date	Signature	Position or title

38 * Append separate sheet if required
39 Translation and further information on the back

GSI – Gesellschaft für Schweißtechnik International mbH, Niederlassung SLV Hannover · Am Lindener Hafen 1, 30453 Hannover · www.slv-hannover.de



KMUTT's Welding Research and Consulting Center
126 Pracha-Utid Rd., Bangmod, Tungkru, Bangkok 10140
Page No. 1 of 3

Welding Procedure Qualification Record (PQR) of Pulsed-Laser Beam Welding

Company:	DSI LASER SERVICE (THAILAND) CO., LTD	PQR Record No:	PQR-DS-Thai Oil-KT-2501-NICR625
Project Name:	Thai Oil-KT-2501 Steam Turbine	Date of original PQR:	February 19, 2024
Laser Make and Model:	ALFLAK1200T	Serial No:	00101120.01.23
Standard/Certificate:	DIN EN ISO 3834-2:2005		
Welding machine type:	Fiber pulsed-laser welding machine with 1075 nm		
Process preformed on this work station:	Pulsed Laser Welding	Specimen Product form:	Plate
Welding Process Type:	Mechanized		
Name of Welding Operator:	MR. THANATPONG DUANGKHEW		

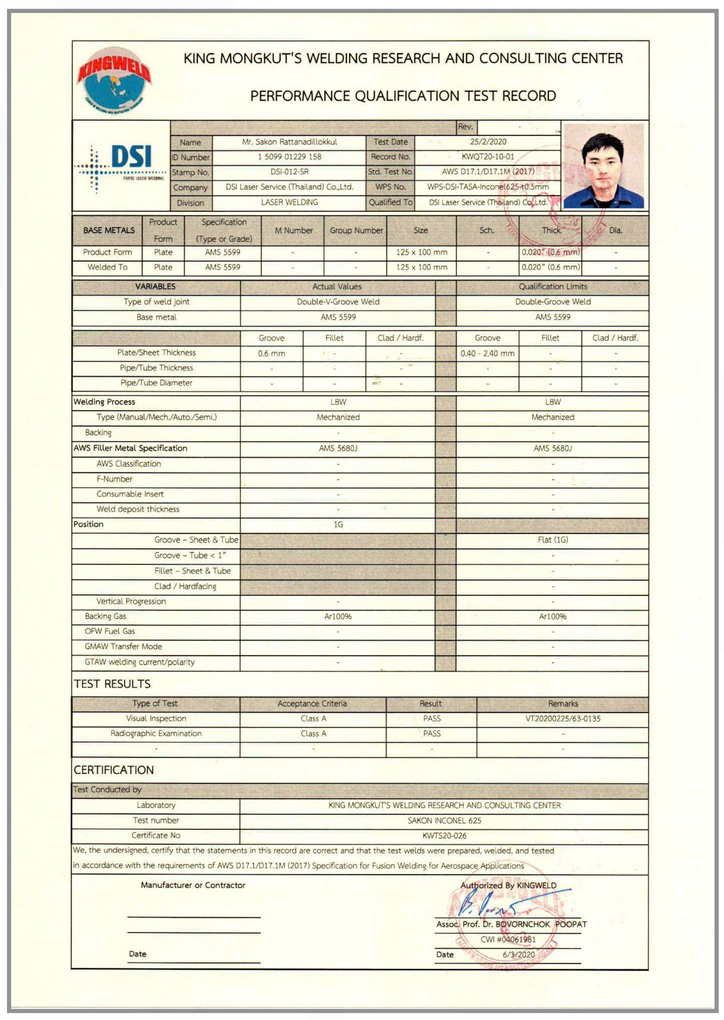
Item	Parameters		
Weld Joint	Units	Actual	Comments
Weld Joint geometry (Lap weld, Butt weld,	-	Butt Joint	-
Type of weld (seam weld, spot weld, stitch	-	Single-V-Groove weld	-
Welding position	-	2G (Horizontal)	

Weld joint preparation | Schematic Welding sequence (top view) | Schematic cross section of the weld

Materials	Actual
Base metal: alloy-workpiece: No.1	ASTM A216WCA
Base metal: alloy-Thickness: No.1	20.0 mm
Base metal: alloy-dimension: No.1	150 x 300 mm
Base metal: alloy-workpiece: No.2	ASTM A216WCA
Base metal: alloy-Thickness: No.2	20.0 mm
Base metal: alloy-dimension: No.2	150 x 300 mm
Materials preparation workpiece No.1 and No. 2	Machining, Sand belt grinding and cleanine by acetone

Note for Welding procedure
1) Cleaning groove face area by griding and acetone wrap
2) Using start-stop tab for starting weld and stoping welding respectively
3) Tack weld by using DSI M NICR625 filler metal
4) Clamping welding specimen using strap clamp to maintain position and again distorsion during welding
5) Interpass cleaning by acetone wrap
6) Control heat distribution and distorsion by using block sequence (as shown in welding sequence pattern)

KINGWELD



KING MONGKUT'S WELDING RESEARCH AND CONSULTING CENTER

PERFORMANCE QUALIFICATION TEST RECORD

				Rev.	-
	Name	Mr. Sakon Rattanadilokkul	Test Date	25/2/2020	
	ID Number	1 5099 01229 158	Record No.	KWQT20-10-01	
	Stamp No.	DSI-012-SR	Std. Test No.	AWS D17.1/D17.1M (2017)	
	Company	DSI Laser Service (Thailand) Co.,Ltd.	WPS No.	WPS-DSI-TASA-Inconel625-t0.5mm	
	Division	LASER WELDING	Qualified To	DSI Laser Service (Thailand) Co.,Ltd.	

BASE METALS	Product Form	Specification (Type or Grade)	M Number	Group Number	Size	Sch.	Thick.	Dia.
Product Form	Plate	AMS 5599	-	-	125 x 100 mm	-	0.020" (0.6 mm)	-
Welded To	Plate	AMS 5599	-	-	125 x 100 mm	-	0.020" (0.6 mm)	-

VARIABLES	Actual Values			Qualification Limits		
Type of weld joint	Double-V-Groove Weld			Double-Groove Weld		
Base metal	AMS 5599			AMS 5599		
	Groove	Fillet	Clad / Hardf.	Groove	Fillet	Clad / Hardf.
Plate/Sheet Thickness	0.6 mm	-	-	0.40 - 2.40 mm	-	-
Pipe/Tube Thickness	-	-	-	-	-	-
Pipe/Tube Diameter	-	-	-	-	-	-
Welding Process	LBW			LBW		
Type (Manual/Mech./Auto./Semi.)	Mechanized			Mechanized		
Backing	-			-		
AWS Filler Metal Specification	AMS 5680J			AMS 5680J		
AWS Classification	-			-		
F-Number	-			-		
Consumable Insert	-			-		
Weld deposit thickness	-			-		
Position	1G					
Groove – Sheet & Tube				Flat (1G)		
Groove – Tube < 1"				-		
Fillet – Sheet & Tube				-		
Clad / Hardfacing				-		
Vertical Progression	-			-		
Backing Gas	Ar100%			Ar100%		
OFW Fuel Gas	-			-		
GMAW Transfer Mode	-			-		
GTAW welding current/polarity	-			-		

TEST RESULTS

Type of Test	Acceptance Criteria	Result	Remarks
Visual Inspection	Class A	PASS	VT20200225/63-0135
Radiographic Examination	Class A	PASS	-
-	-	-	-

CERTIFICATION

Test Conducted by	
Laboratory	KING MONGKUT'S WELDING RESEARCH AND CONSULTING CENTER
Test number	SAKON INCONEL 625
Certificate No	KWTS20-026

We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of AWS D17.1/D17.1M (2017) Specification for Fusion Welding for Aerospace Applications

Manufacturer or Contractor

Authorized By KINGWELD

Assoc. Prof. Dr. BOVORNCHOK POOPAT
CWI #04061981
Date 6/3/2020

Pulse Laser Welding

Qualification & Standards

Standards & Norms used by *DSI Laser Service (Thailand)* / Selection

Quality assurance management

DIN EN ISO 3834-2:2021

Education / Laser Beam Specialist

DVS 1187-2:2021-09

Quality / Examination

DIN EN ISO 13919-1:1996-09

DIN EN ISO 6520-1:2007

Process Qualifications

DIN EN ISO 15609-4:2009-10

DIN EN ISO 15613:2004-09

DIN EN ISO 15614-7:2007

DIN EN ISO 15614-11:2002

American Welding Society Standards (AWS)
Process Specifications

AWS B2.1/B2.1M:2021

AWS C7.4/C7.4M:2017

AWS D14.6/D14.6M:2024

AWS Standards for Aerospace

AWS D17.1/D17.1M:2024

Safety Training
Laser Radiation / Laser Welding

DGUV Vorschrift 11 (Former BGV-B2)

ANSI Z136.1-2014 (American Standard)

Laser Welder and Laser-welding-machine Operator Training

DIN EN ISO 14732:2013-12

DIN ISO 24394:2021-05

SLV-H-LS0 acc. to EN ISO 9606-1:2017

Filler materials / Laser Welding Wires

EN 10204 Type 3.1

Filtration Systems / Dust Collection

DIN EN ISO 14121-1

ASME Standards
Boiler and Pressure Vessel Code

ASME BPVC 2023 Section IX

AWS Standards for Space Systems

ANSI/AIAA S-080A-2018

Japan Industrial Standard (JIS)
Laser Welding

JIS Z 3001-5

Good to know : Pulse Laser Welding Technology can follow ***any*** welding standard and ***any*** weld examination.

Pulse Laser Welding

Quality Assurance

Equipment Qualification Record (EQR)



The verification, qualification and record of Pulse Laser Welding related equipment (EQR) *DSI-Thailand* verified in accordance with **ISO 3834-2:2021** and **ISO 14732**

Equipment Calibration

Record result in an EQR

Perform according to the records



DSI
PULSE LASER WELDING

Pulse Laser Welding

Quality Assurance

Laser Welder & Operator Qualification



The Qualification of Pulse-Laser-Welders and PLWelding-Machine-Operators (WOPQR) conducted according to **ISO 9606-1**, **SLV-H-LS01**, **ISO 14732** and **AWS C7.4/C7.4M:2017**

Test-site administrator

Laser shop assistant

Training :
Laser welding /
Safety /
Laser Welding and
Machine operator

DSI-Academy
Module 1 -
Module 5

Qualification tests

Test coupons

Standard materials or representative materials

Manual Wire Feeding

Automatic Wire Feeding

Welding evaluation :
Visual inspection /
Leak test /
Peeling test /
Fracture testing /
Metallography test

NG

OK

Re-test within 90 days

NG

Cannot re-test for 6 months

OK

WOPQR (draft) completed by Applicant

Welding evaluated by administrator: Metallography

NG

OK

Approved and signed official WOPQR

Copy to WO

NG = Failed to meet quality requirements

OK = Quality requirements passed

DSI
PULSE LASER WELDING

Pulse Laser Welding

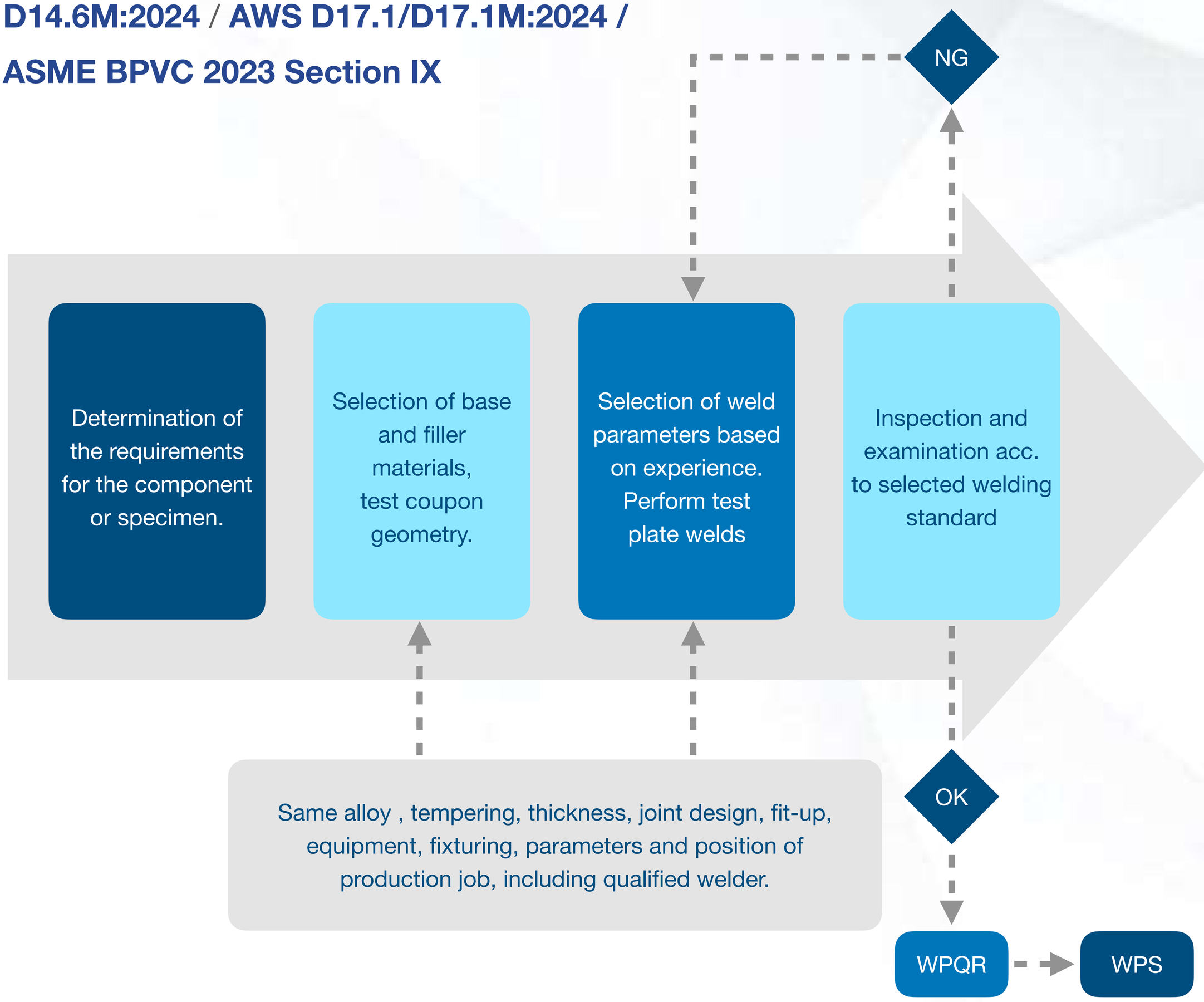
Quality Assurance

Laser Welder Procedure Qualification



The Pulse Laser Welder Procedure Qualification and Specification (**WPRQ / WPS**) *DSI-Thailand* conducted according to :

ISO 15609-4:2009-10 / **ISO 15614-7:2007** / **ISO 15614-11:2002** / **AWS D14.6/ D14.6M:2024** / **AWS D17.1/D17.1M:2024 / ASME BPVC 2023 Section IX**



WPQR = Welding Procedure Qualification Record

WPS = Welding Procedure Specification

NG = Failed to meet quality requirements

OK = Quality requirements passed

Pulse Laser Welding

Premium Quality - Trust but verify !

Qualification, Certification and Refurbishment Process (sample)

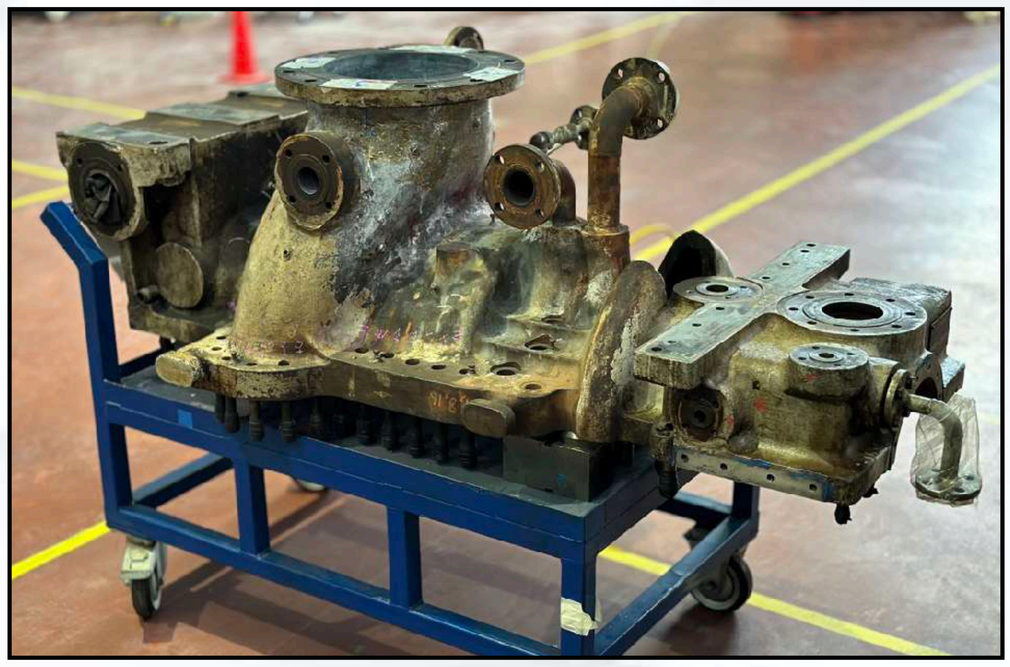
Component : Recycle Gas Compressor Steam Turbine Casing.

Base Material : ASTM A216 WCA

Identified problem : Partially corroded exhaust nozzle / critical minimum wall thickness almost reached.

Selected repair Technology : Pulse Laser Welding

Selected Filler Material : DSI M NiCr625



Qualification & Certification by authorised Third Party

Qualification and Certification prior to refurbishing :

Welding Procedure Qualification Record (WPQR)

Welding Procedure Specification (WPS)

PLWelder and PLWelding-Machine Operator (WOPQR)







Quality Control - QC - by authorised Third Party during and after PLW

Inspection by Faro arm

Distortion control via dial gauges

Visual Testing (VT)

Liquid Penetrant Testing (PT)

Magnetic Particle Testing (MT)

Ultrasonic Testing (UT)

Radiographic Testing (RT)



Turbine Casing
Video DSI-Dropbox

Pulse Laser Welding : Premium Quality : Verified. Proved. Published.

The successful refurbishment of this Steam Turbine Casing was published in the Magazine of German Welding Society ***Welding and Cutting*** (issue 2/2025)

„Pulse Laser Welding Leads the Race - Refurbishment of the Eroded Outlet Nozzle of a Recycled Gas Compressor Steam Turbine Casing“


WELDING & CUTTING | REPORT

Refurbishment of the Eroded Outlet Nozzle of a Recycled Gas Compressor Turbine Housing

Pulsed Laser Beam Welding Leads the Race

During the routine inspection of the inner casing of a steam turbine, erosion related wear was detected, particularly in the area of the gas outlet nozzle. Partial deposition welding was considered as a repair method to prevent an imminent plant shutdown if the wall thickness failed to meet the minimum requirements. Due to its unique advantages, especially in conjunction with the tight schedule, the customer project lead manager decided in favour of pulsed laser beam welding.

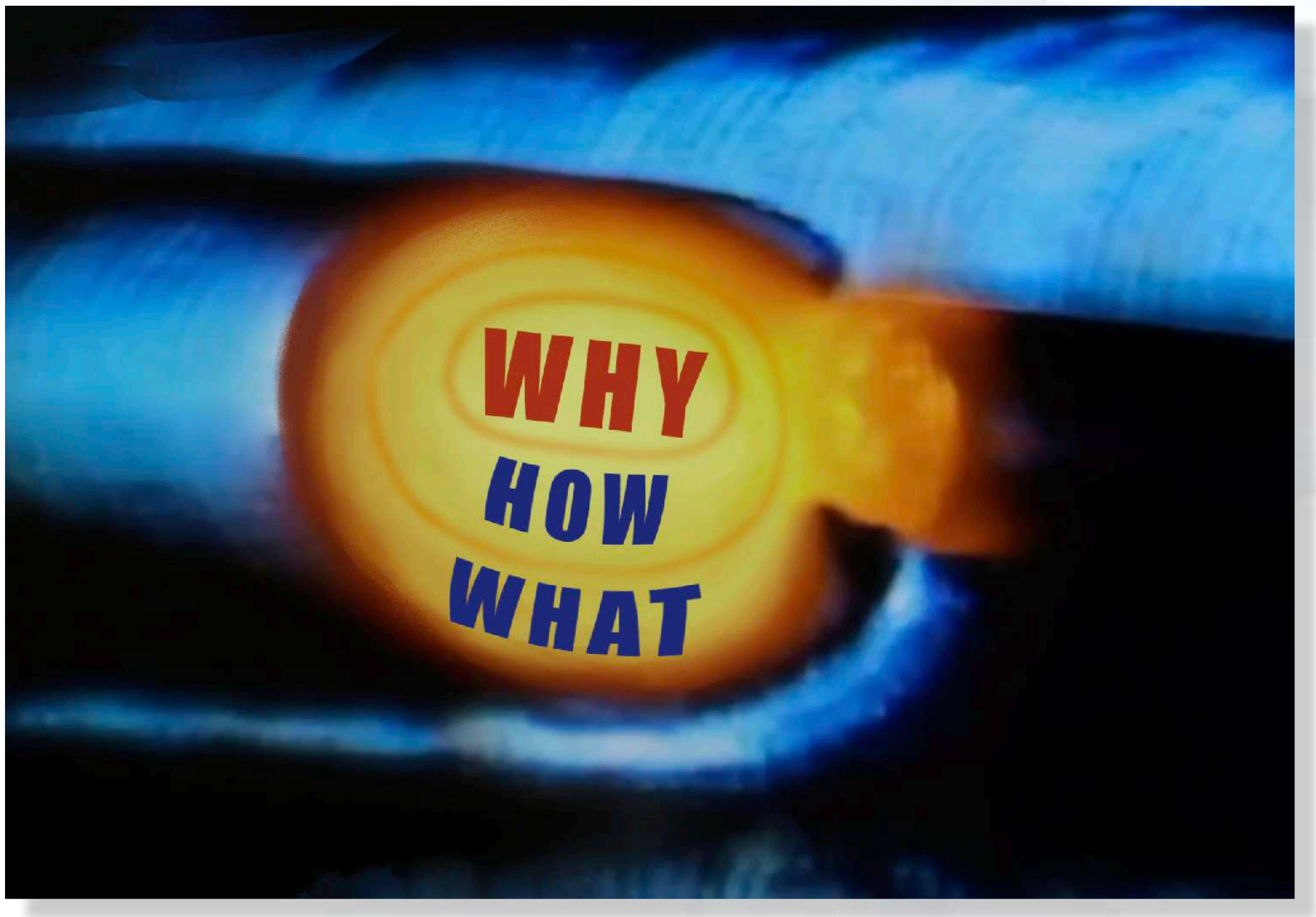
Turbine Casing
Article DSI-Dropbox

Pulse Laser Welding

Basic Understanding

Being curious is a human characteristic. In any chapter of life - both in our private and professional. Curiosity is needed to learn, to understand, to develop. It's the ignition to get in touch with a new or not yet well known Technology. Like Pulse Laser Welding, which is a game changer in maintenance and refurbishment.

The core of the curiosity is called the ***Golden Circle of Pulse Laser Welding.***



Our curiosity guides us to the very first and most relevant questions :

WHY Pulse Laser Welding is needed ?

Followed by :

HOW Pulse Laser Welding can provide its unique advantages ?

WHAT are the applications of Pulse Laser Welding ?

This handbook provides answers to these and many other questions that arise from curiosity about „Welding with pulsed Light and its Speed".

The most easiest way to get in touch with PLW-Technology is the question : „**HOW** classical arc-welding technologies works?"

Pulse Laser Welding

Basic Understanding

HOW classical arc-welding technologies works ?



GTAW



GMAW



SMAW

Classical arc-welding methods use *electricity*.

They *continuous* provide *heat* until the metal melts until the needed melting pool is present.

By applying *continuous heat* to metal causes some negative effects :

- → Microstructure Changing
- → Coarse Grain Formation
- → Graphitisation
- → Thermal Distortion
- → Residual Stress
- → Brittle Structure in the Heat-Affected Zone (HAZ)
- → Unacceptable Welding Discontinuities and Defects

And for some materials it requires :

- → Pre- or Post Weld Heat Treatment (PWHT)

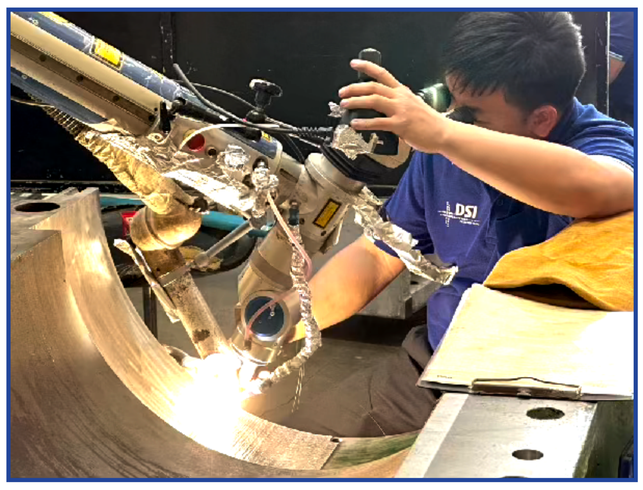


Conclusion : Classical arc-welding methods provides *negative* influences regarding mechanical- and metallurgical properties.

Pulse Laser Welding

Basic Understanding

HOW Pulse Laser Welding technology works ?





Pulse Laser Welding creates the melting pool by *pulsed Light* and *its Speed*

by *Photons* - travels at 300,000 km/s.

Pulse Laser Welding is happen *within a split of second* means :

- ➜ Release energy supply …
- ➜ Create the molten bath …
- ➜ Add filler material …
- ➜ Stop energy supply …
- ➜ Complete solidification of the molten bath …

… while ***all unique advantages*** are provided.

Pulse Laser Welding Process
1.) Original Speed
2.) Thermo Camera
3.) Super Slow Camera
Video DSI-Dropbox

Based on always full metallurgical bonding :

- ✓ Very low heat input (only about 30 Joules) / very thin HAZ (0.1-0.3 mm)
- ✓ No critical microstructure changing / No coarse grain formation
- ✓ No pre- or post weld heat treatment / welding at room temperature
- ✓ No graphitisation / related to welding (gray) cast iron
- ✓ Almost no thermal distortion / very precisely

Conclusion : Pulse Laser Welding does ***NOT*** provide negative influences regarding mechanical- and metallurgical properties.

Pulse Laser Welding

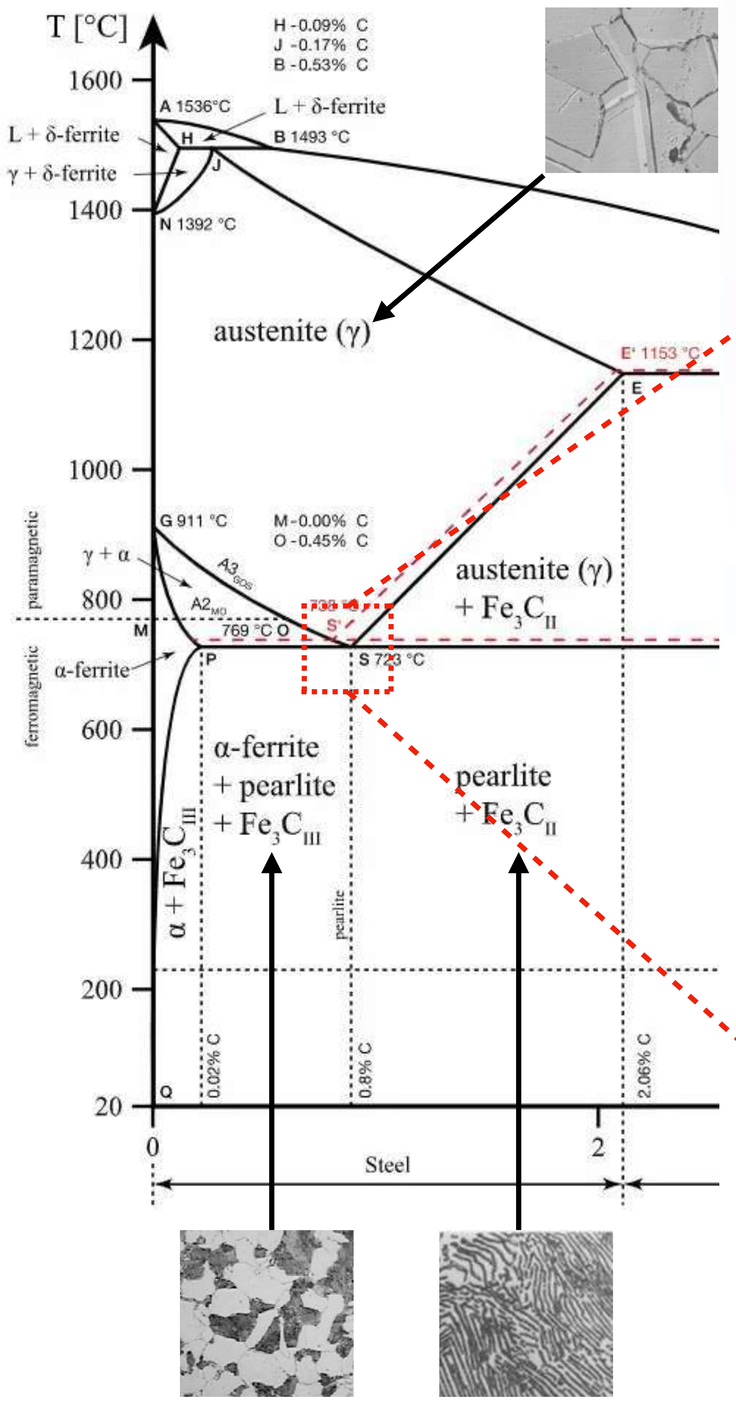
Basic Understanding

WHY Pulse Laser Welding can provide all unique advantages ?

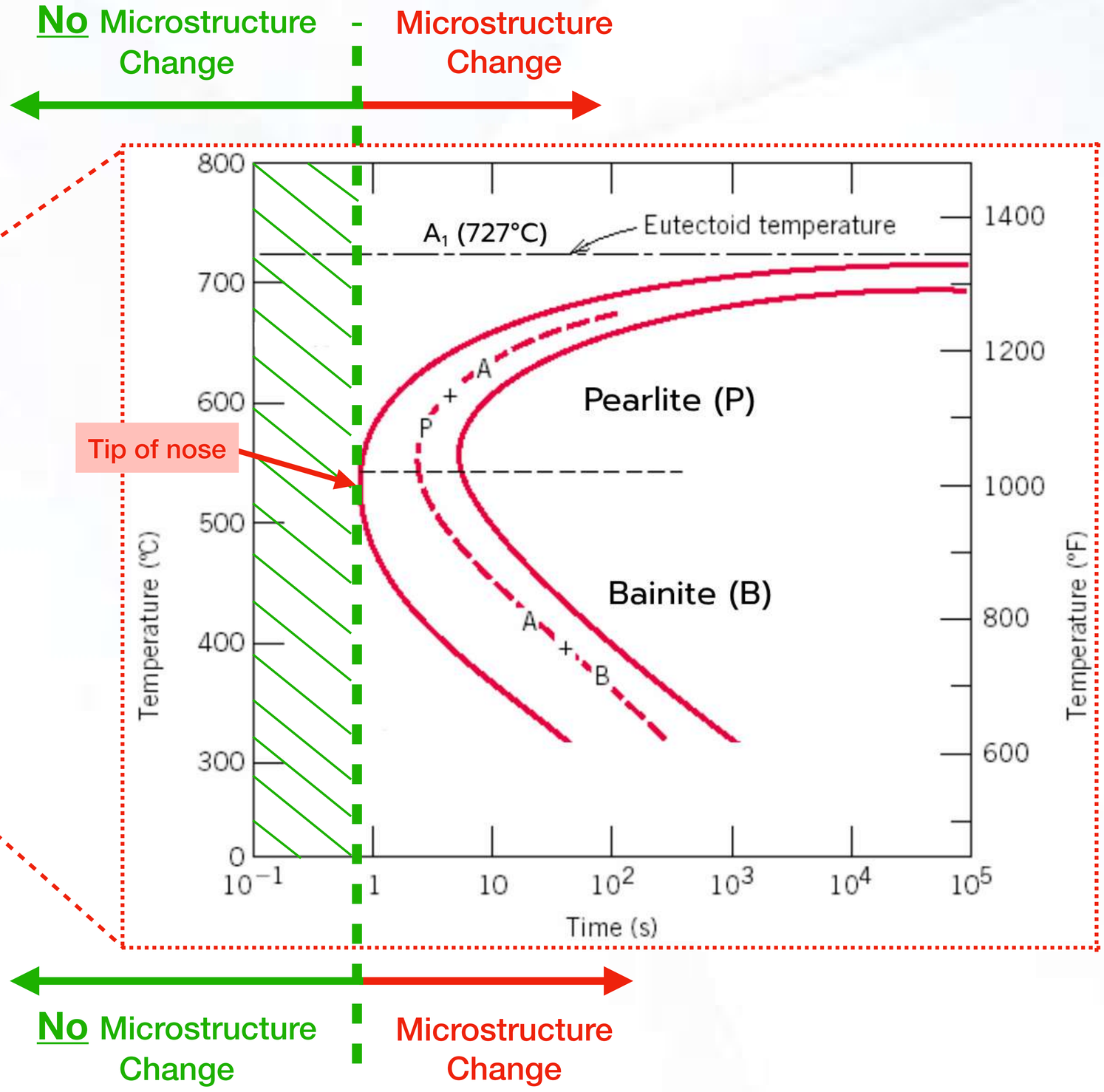
Any metal material reacts to heat exposure - BUT only *after about 1 second*.

Within the first second of applying heat, the metal does not react - for instance with microstructure changing or coarse grain formation.

Pulse Laser Welding is happen only within few milliseconds - within *less than 1 second*. Means : The metal doesn't feel that its getting welded - and therefore it does not react.



Phase diagram Fe-C



Time-Temperature-Transformation (TTT) Diagram

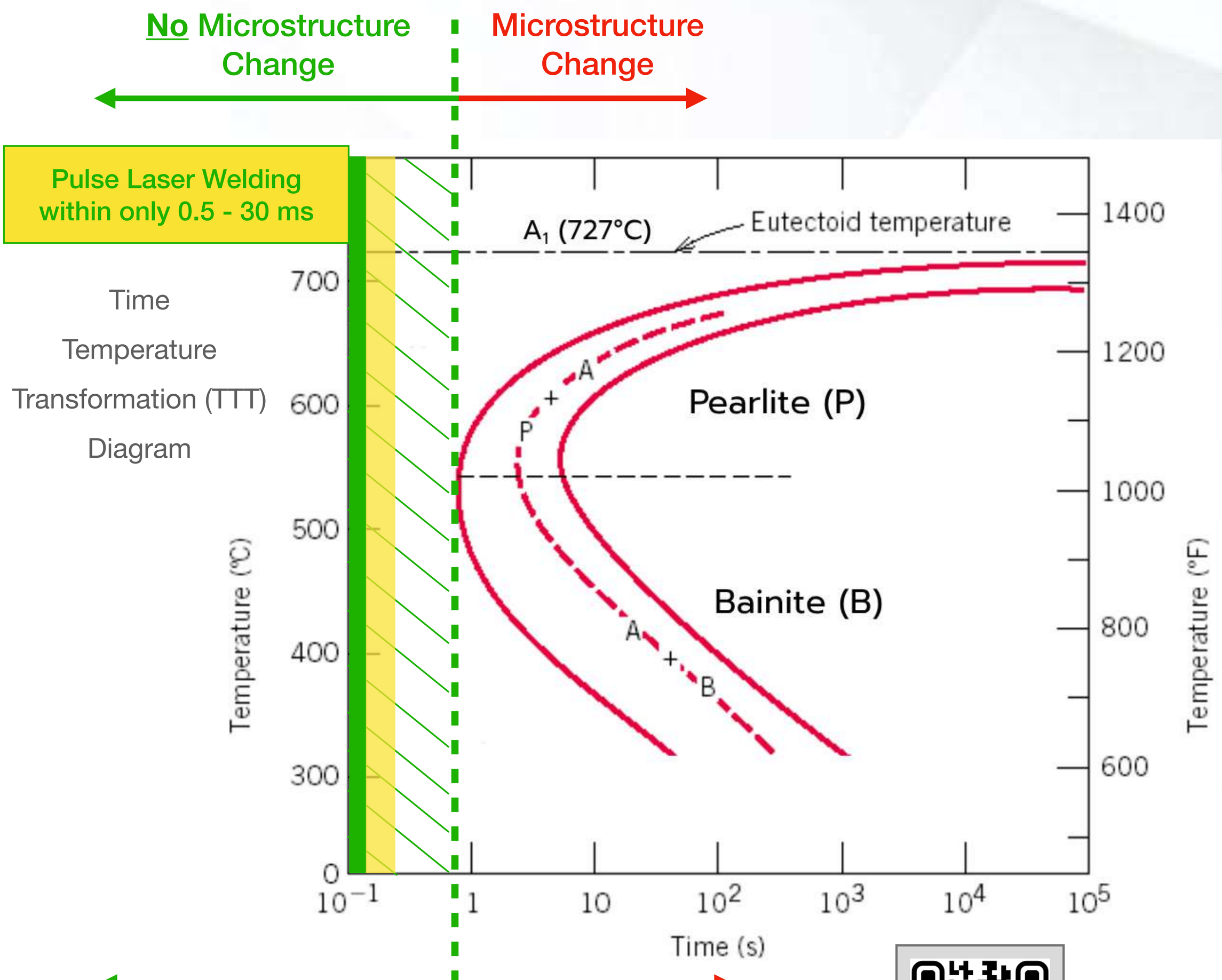
Pulse Laser Welding

Basic Understanding

Pulse Laser Welding is *UNIQUE* !

Pulse Laser Welding has *NONE* competitive Technology !

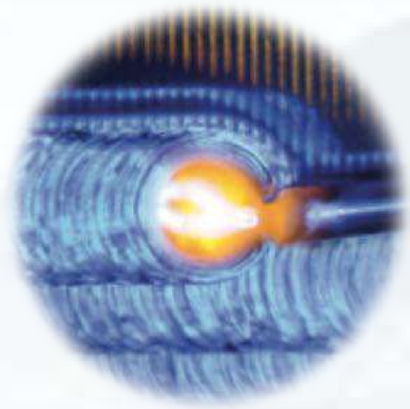
Because only by ***welding with pulsed light and its speed*** all unique advantages can be earned - at the ***Tiny-giant Playground*** which is ***unreachable for any other welding or cladding method***.



Pulse Laser Welding
Melting Pool
Video DSI-Dropbox

Pulse Laser Welding

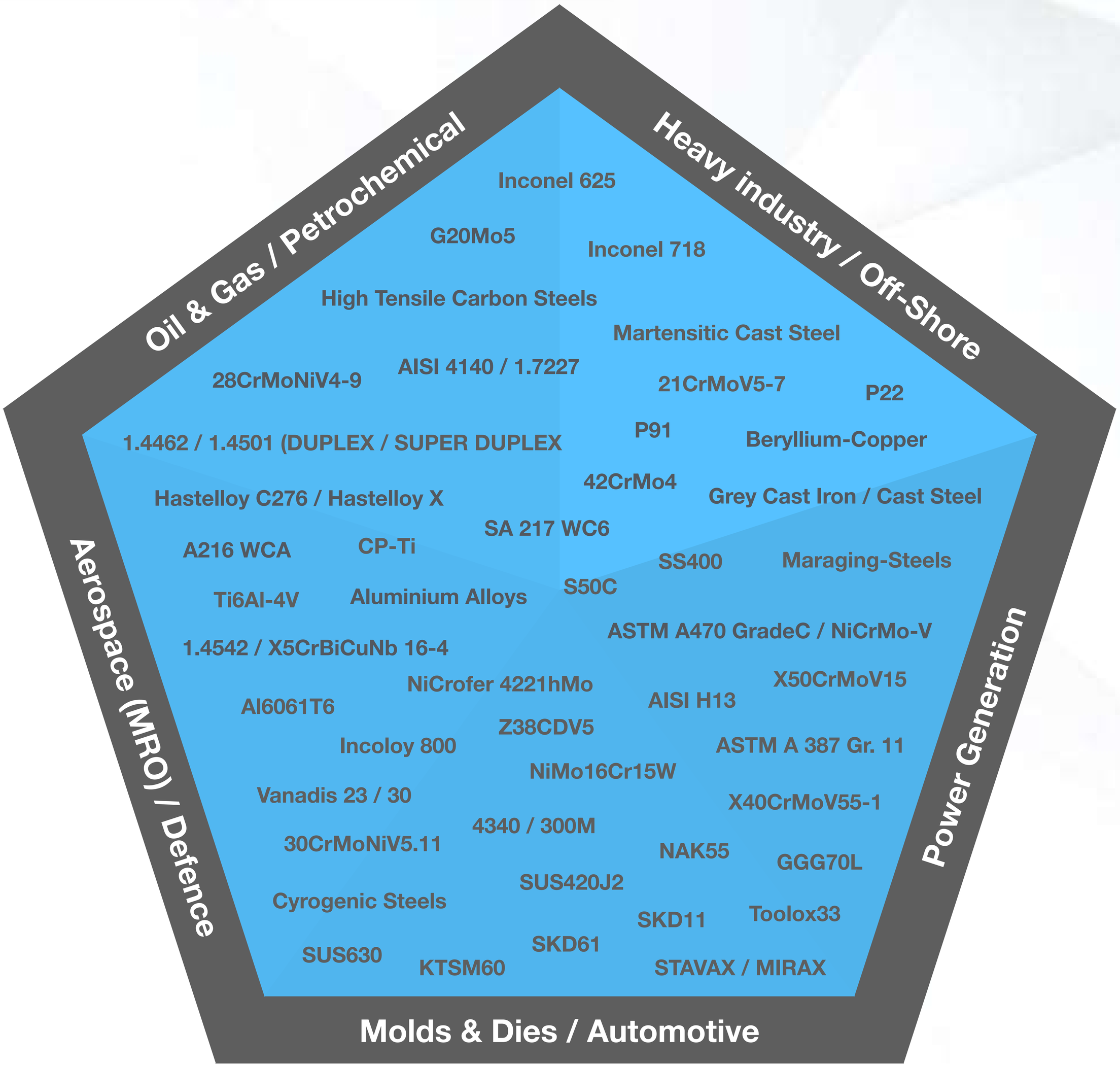
Basic Understanding



Good to know : The Technology of Pulse Laser Welding provides (almost) unlimited applications. Based on always full metallurgical bonding, **ANY metal material** can be welded by pulsed Light and its Speed. „**WHY?**“ → page 17.

Therefore PLW-Technology is successfully applied in any industrial sector.

Base Materials (Selection)



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Pulse Laser Welding

Basic Understanding

WHY the pulsed Laser can weld *any* metal material ?

WHY the pulsed Laser can even *join very different* base materials ?

WHY any Laser Welding Wire can be *deposited on any* base metal material ?

Classical arc welding methods like GTAW, GMAW, SMAW allows to adjust only *one* or max. *two* parameter : Welding Current / Ampere [A]

Welding arc voltage [V]





Welding Current [A]

Pulse Laser Welding allows to adjust *FIVE* different parameters

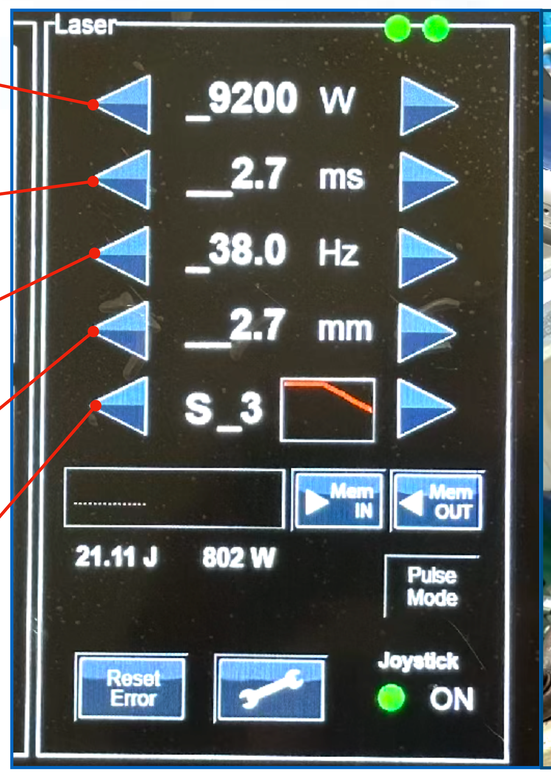
Peak Power [W]

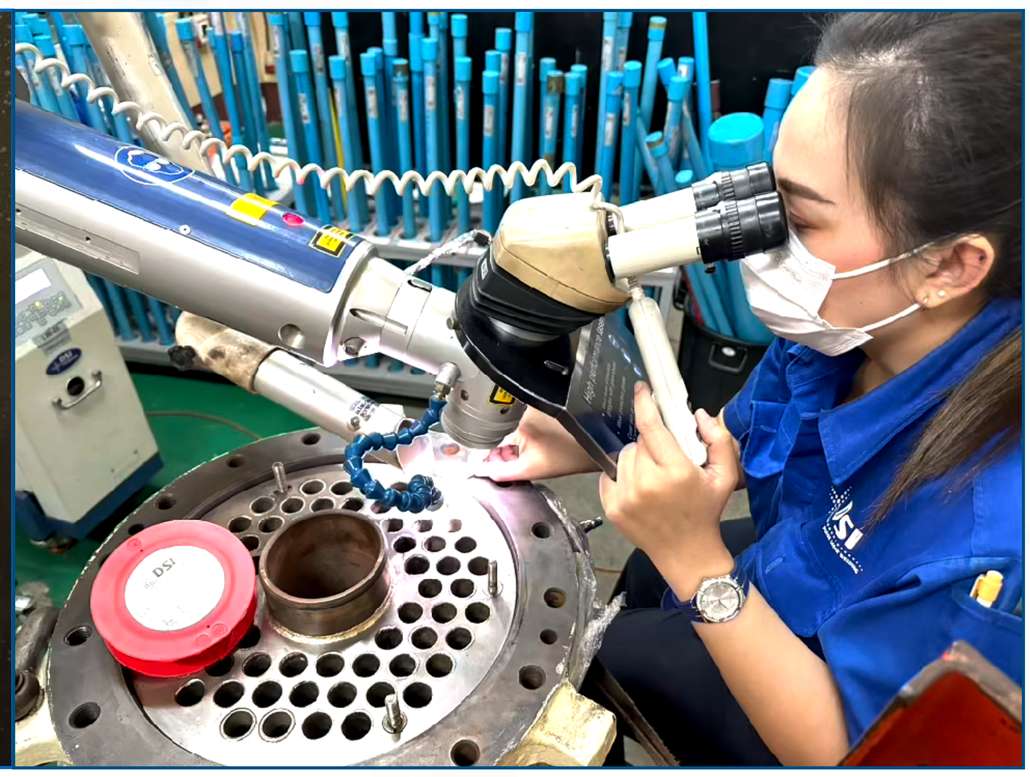
Pulse Duration [ms]

Frequency [Hz]

Beam Diameter [mm]

Pulse Shape [1-5]





PLW Stainless Steel with Bronze Video DSI-Dropbox

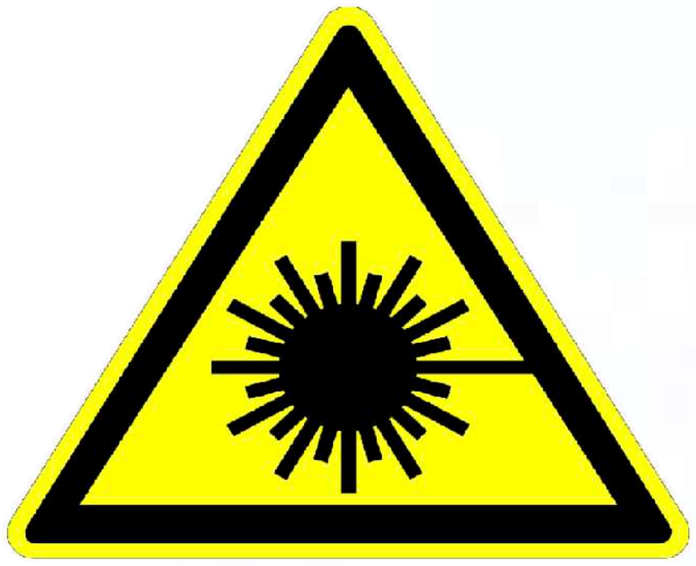
Conclusion : By adjusting those five parameters in a correct composition, any metal material can be welded and joined. More applications → page 32.

Pulse Laser Welding

Basic Understanding

WHAT does **LASER** means ?

It is an abbreviation of …



L ight

A mplification by

S timulated

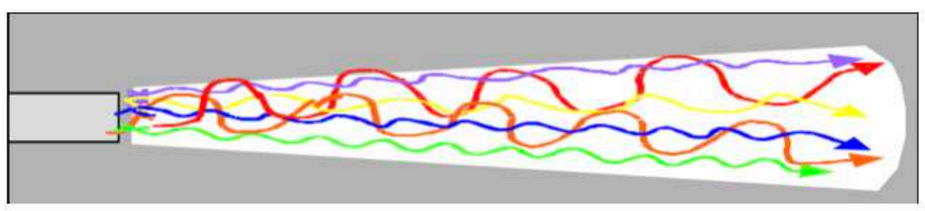
E mission of

R adiation

WHAT is the difference between **Light Bulb** & **Torch** and **Laser** ?

Light Bulb & Torch



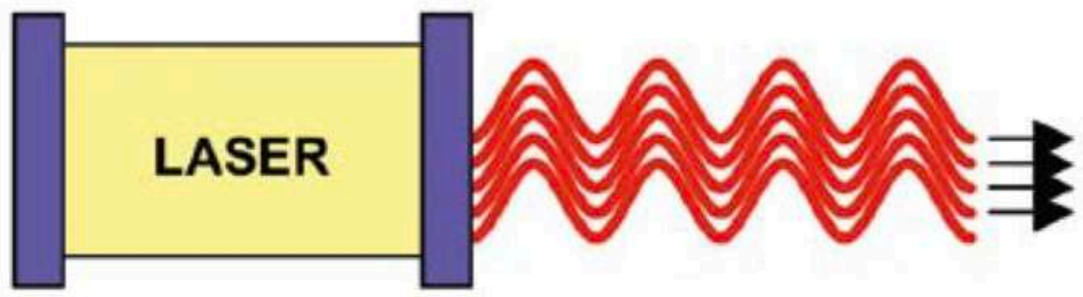


→ **Different** Wave Length

→ **Different** Colour

→ Waves **are not** synchronised

Laser = Coherent



→ **Same** wave length

→ **Same** colour

→ Waves **are** synchronised



Conclusion :

Light Bulb & Torch can **never** show the characteristics of **Laser** !

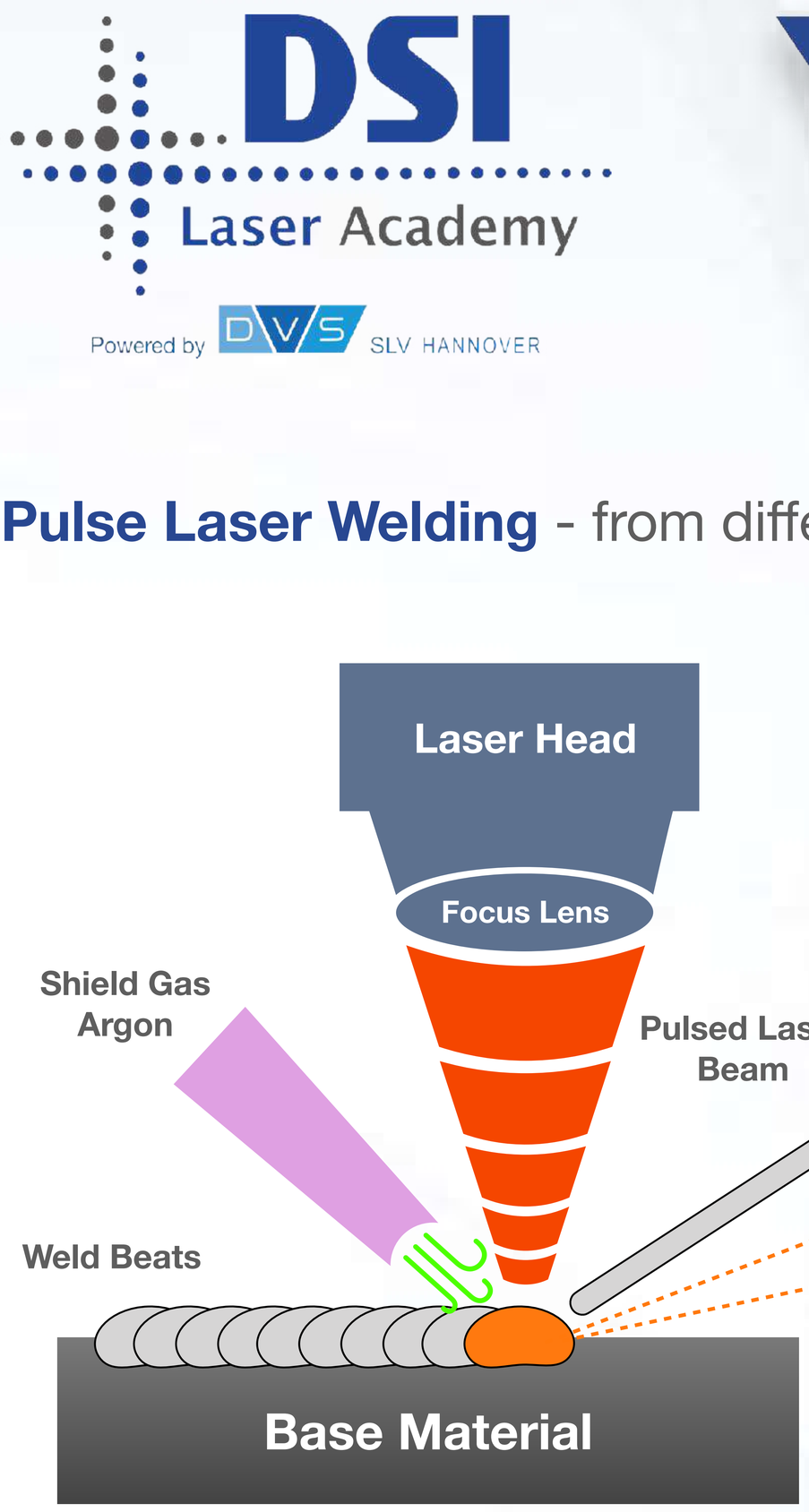
DSI Laser Academy

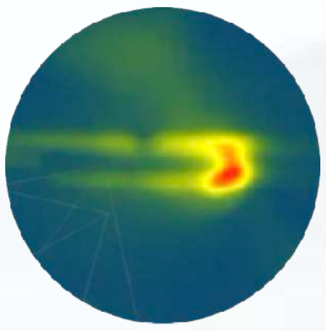
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Pulse Laser Welding

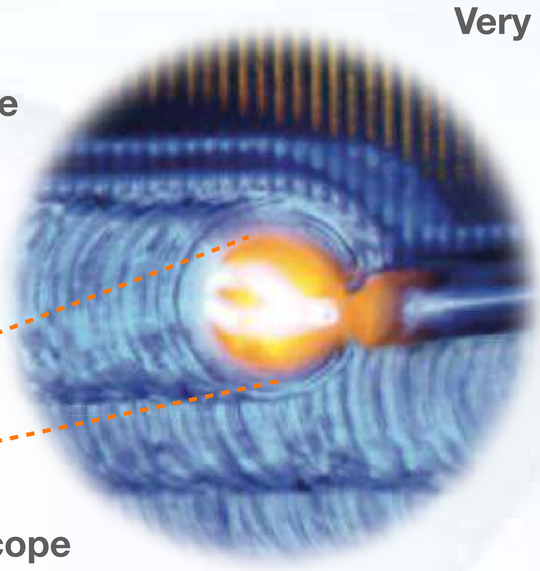
Basic Understanding

Pulse Laser Welding - from different point of views

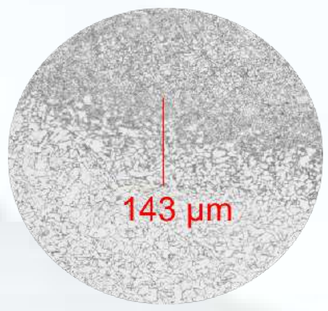




Thermal Camera
Very low heat input



16 X Microscope
Melting Pool



Micro Cross Section
Very narrow HAZ



Macro Structure of welded Cross Section
Full metallurgic bonding

Comparison of Thermal Metal Deposition Methods

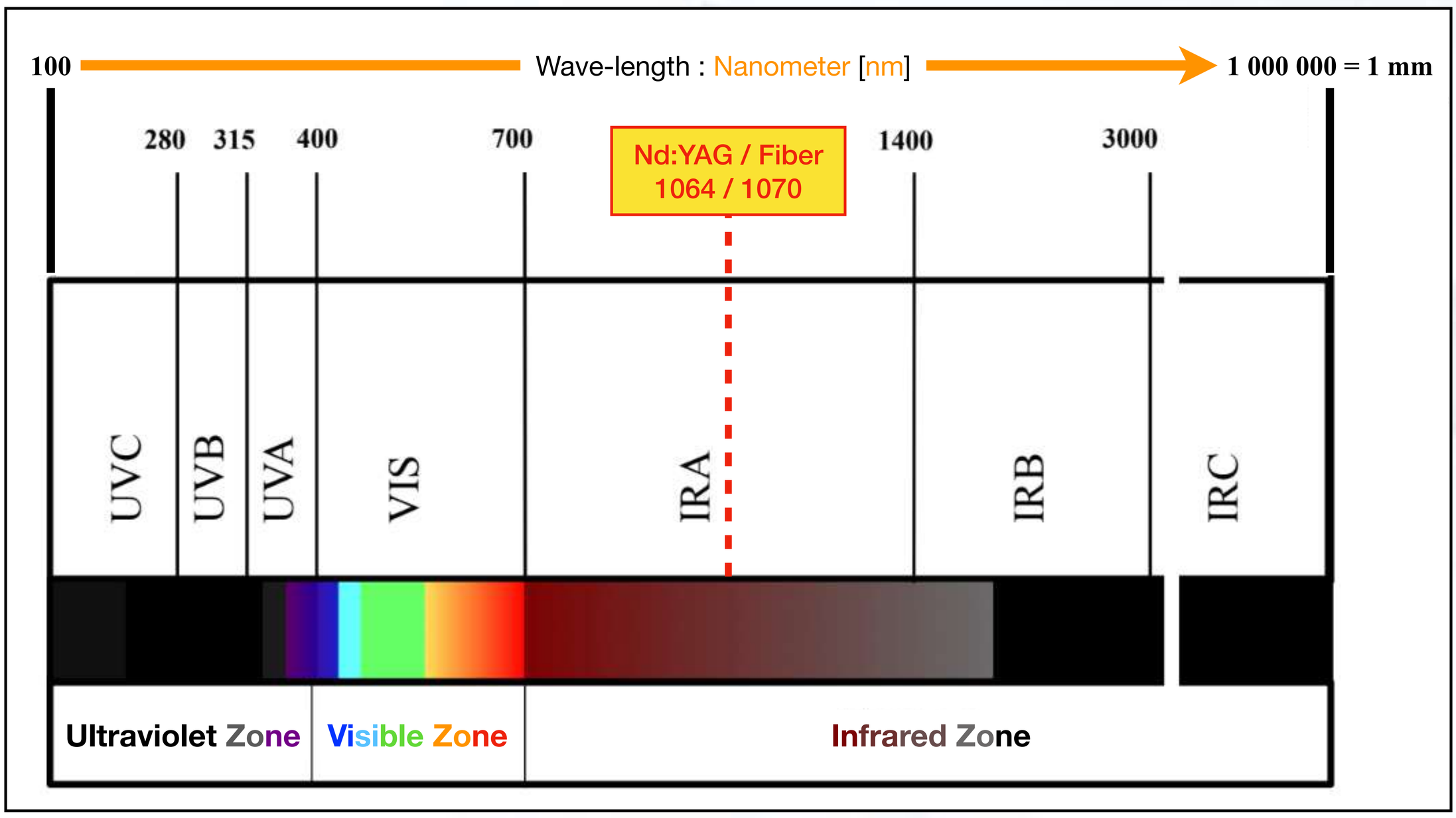
	Pulse Laser Welding	PTA	Laser Cladding	SMAW	HOVF
Source of Energy Input	Pulsed Laser Beam	Plasma / Electric Arc	CW Laser Beam	Electric Arc	Gas Flame
Heat Input	Low	High	Low / Medium	High	Low
HAZ Material SUS 431	0.05 - 0.3 mm	3.0 mm	0.1 - 0.4 mm	3.0 - 4.0 mm	0 mm
Bonding Type	Metallurgical	Metallurgical	Metallurgical	Metallurgical	Mechanical
Bonding Strengt	>1000 Mpa	<800 Mpa	<800 Mpa	>800 Mpa	<80 Mpa
Heat Treatment Required	No	Yes	Yes	Yes	No
Deposition thickness	Unlimited	0.5 - 5.0 mm	0.1 - 10 mm	Unlimited	0.05 - 0.5 mm
Deposit Rate	0.1 - 0.35 kg/hr	1 - 5 kg/hr	1 - 30 kg/hr	1 - 30 kg/hr	1 - 9 kg/hr
Porosity	100 % dense	100 % dense	100 % dense	100 % dense	>5 %

Pulse Laser Welding

Basic Understanding

WHY the pulsed laser is invisible ?

Pulse Laser Welding uses two different types of solid-state lasers. „**Nd:YAG**“ with a wave length of 1064 Nanometer [nm] and „**Fiber Laser**“ with a wave length of 1070 Nanometer [nm]



Good to know :

Nano is a Greek word and means Dwarf.

Hardly to imagine : 1 Nanometer [nm] is the billionth part of 1 meter.

Easy to imagine : 1 Nanometer relates to the size of a soccer ball as a soccer ball does to the size of our earth.



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Pulse Laser Welding

Heat Affected Zone (HAZ)

"HAZ - The most feared Danger Zone in Welding Technology"

WHAT is the Heat Affected Zone (HAZ) ?

It's the area of the base metal that's been affected by the heat input during welding — but without melting: The metal didn't melt, but its microstructure changed due to the heat exposure.

WHY is the HAZ important and potentially dangerous ?

Because microstructure changes may lead to :

- Lost of mechanical properties
- Crack susceptibility
- Loss of toughness and low ductility
- Formation of delayed cracks

This is especially critical in materials like :

- Medium and high carbon steels
- Heat-treated metals
- Heat-sensitive alloys

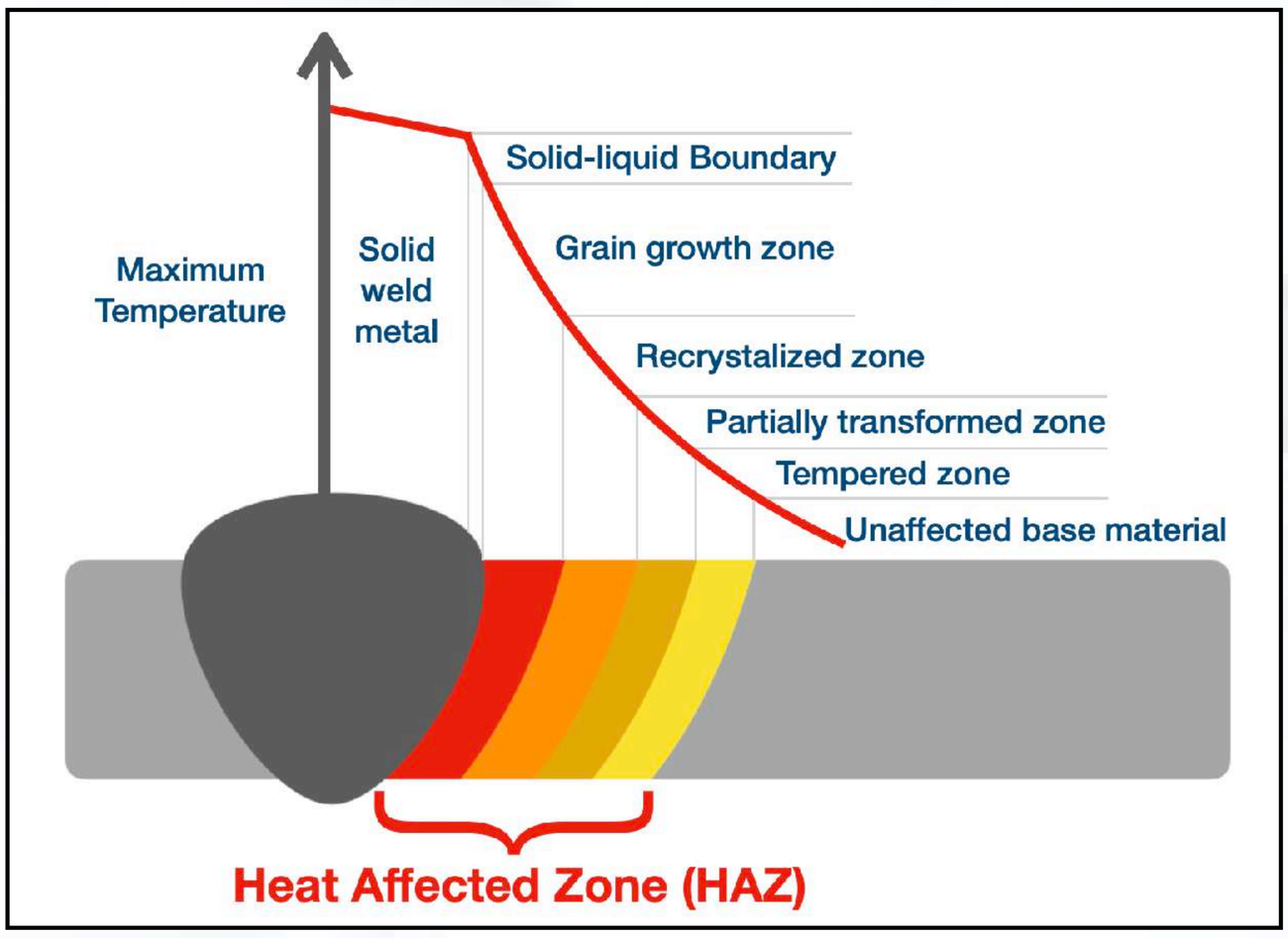
HOW do we detect problems in the HAZ ?

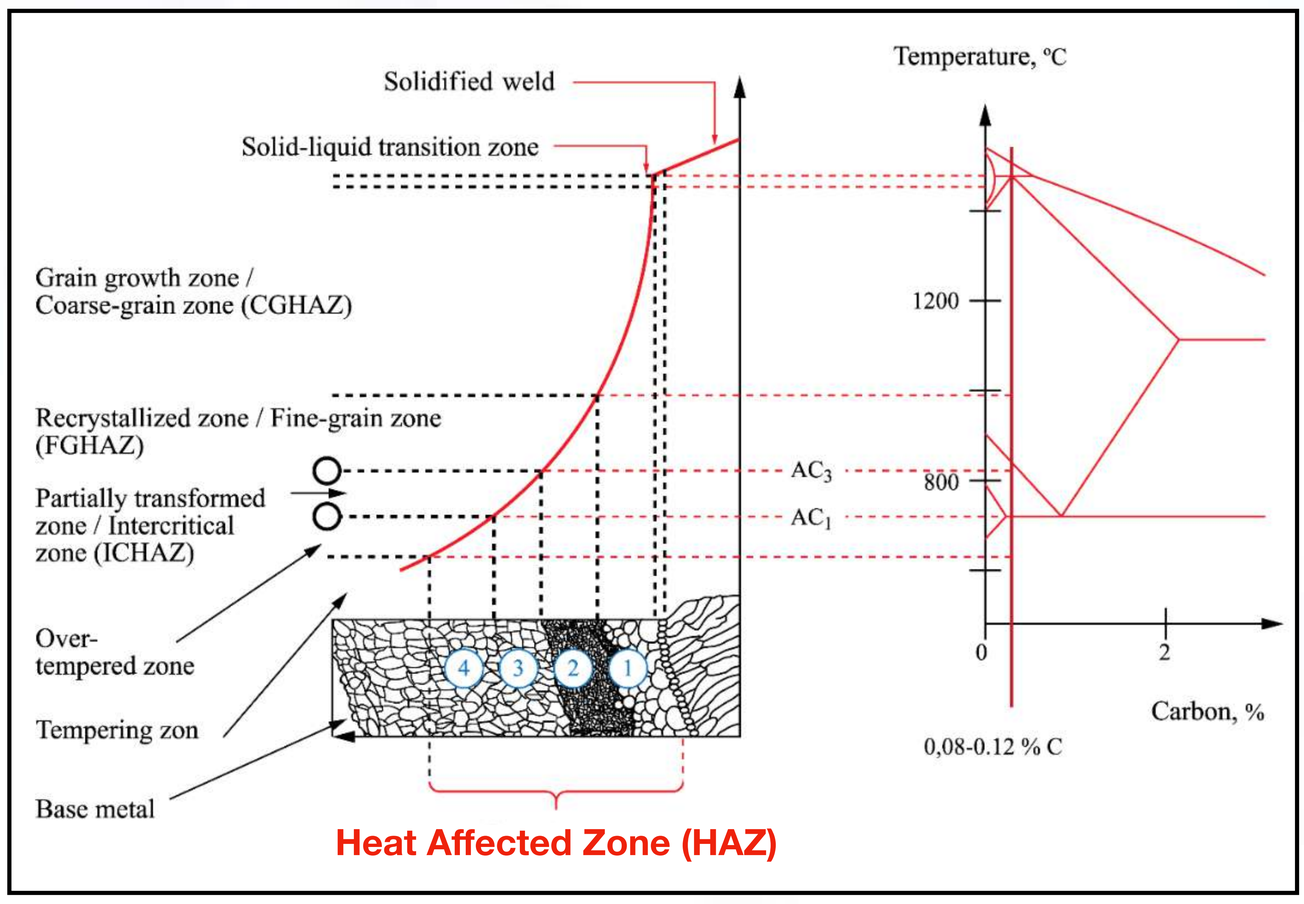
By applying following inspection techniques:

- Visual Testing (VT)
- Ultrasonic Testing (UT)
- Liquid Penetrant Testing (PT)
- Magnetic Particle Testing (MT)
- Radiographic Testing (RT)
- Hardness Testing
- Bending Testing
- Metallographic Examination

WHICH factors affect the HAZ ?

- Welding temperature and heat input
- Welding Process
- Cooling rate
- Type of base metal
- Welding method
- Thickness and size of base metal
- Pre- or Post-Weld Heat Treatment (PWHT)







Conclusion & Technological Solution :

- The wider the HAZ, the higher the risk of weakened metal.
- Pulse Laser Welding Technology provides a premium HAZ property because of its very low heat input (about only 30 Joule / AL-1200F)

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Pulse Laser Welding

Heat Affected Zone (HAZ)

HAZ – The most feared “Danger Zone” in welding technology

A transnational investigation project :

This project was carried out by *DSI-Thailand-Academy* together with *German Welding Society DVS SLV Hannover* and *Thai German Institute (TGI).* The target was to investigate the width of the HAZ by comparing three different welding methods: two classical arc-methods, SMAW (111) and MAGW (135), with Pulse Laser Welding (521). The latter use photons as energy source, i.e. bundled, rectified, pulsating light particles and their speed – melting metal and welding at 300,000 km/s !

Base material, welding specimen :

- Base material : S355J2+N structural steel (DIN EN 10025-2).
- Quantity : Six samples (12 × 100 × 100 mm)
- Method : two by manual arc, two by metal active gas, and two by pulsed laser welding
- Condition : single-layer weld and three-layer weld

Case study 1 : Shield Metal Arc Welding (SMAW / 111)

- Welding filler material : EN ISO 2560-A E 38 2 RB 12/AWS A5.1: E6013
- Electrode diameter : 4 mm/rutile-basic coated,
- Type of welding machine : FRONIUS “TransPocket 180”/amperage: 160A.

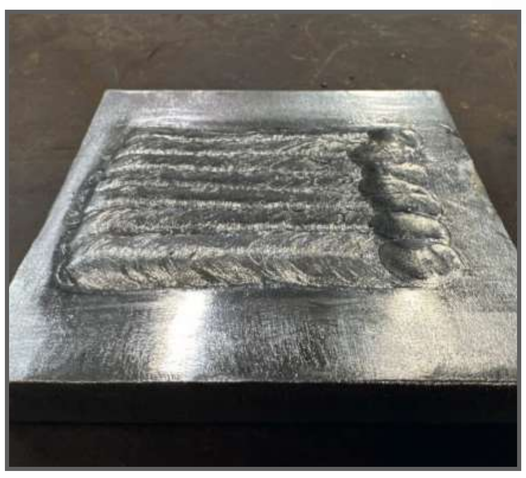


Fig. 1: Single-layer
(© DSI-Thailand)

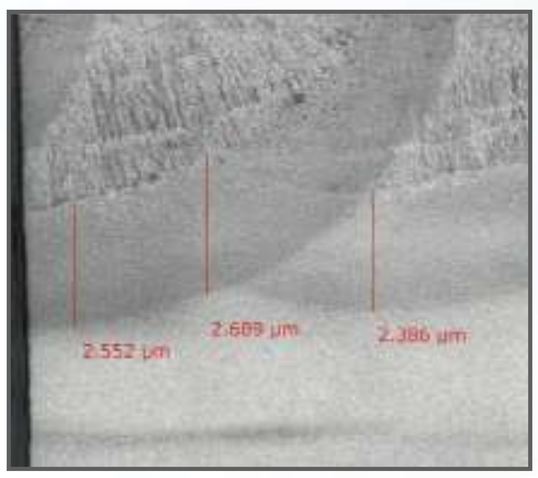


Fig. 2: Single-layer
(HAZ 2.4 mm-2.7 mm)
(© DSI-Thailand)



Fig. 3: Three-layer
(© DSI-Thailand)

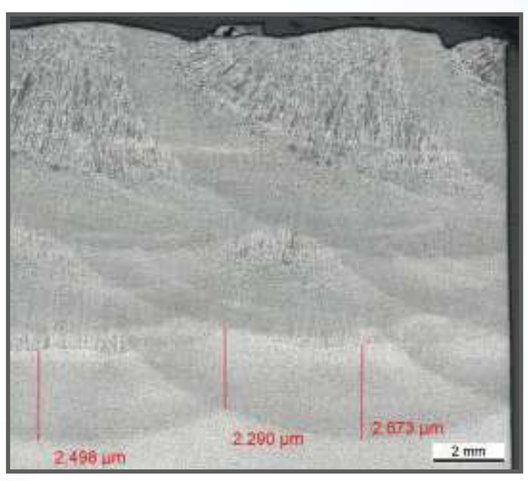


Fig. 4: Three-layer
(HAZ 2.2 mm-2.7 mm)
(© DSI-Thailand)

Case study 2 : Metal Active Gas Welding (MAGW / 135)

- Welding filler material : AWS A5.18: ER70S-6 / solid wire / dia. 1.2 mm
- Shielding gas mixture : M21 (argon 82 %/CO2 18 %)
- Type of welding machine : FRONIUS “TPS 4000”/current: 170 A



Fig. 5: Single-layer
(© DSI-Thailand)

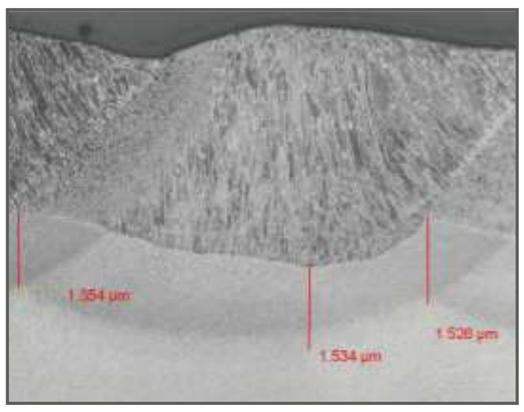


Fig. 6: Single-layer
(HAZ 1.4 mm-1.7 mm)
(© DSI-Thailand)



Fig. 7: Three-layer
(© DSI-Thailand)

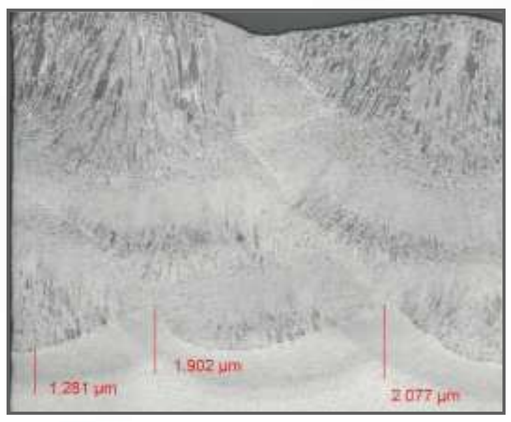


Fig. 8: Three-layer
(HAZ 1.3 mm-2.1 mm)
(© DSI-Thailand)

Pulse Laser Welding

Heat Affected Zone (HAZ)

Case study 3 : Pulsed Laser Welding (PLW / 52)

- Welding filler material : DSI M90 / 1.5424 / 10MnMo4-5
- Welding machine : “ALPHA LASER / AL Flak 1200 F” (Type : Fiber Laser 1070 nm)
- Welding parameters : Pulse laser power 1200 W / beam diameter 2.4 mm / pulse duration 2.8 ms pulse frequency 34.0 Hz / shielding gas 12l/min / Argon 4.6.

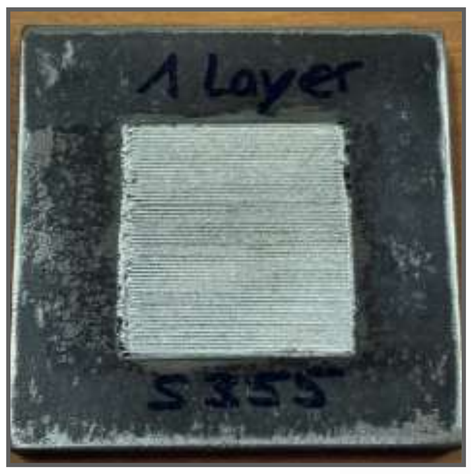


Fig. 9: Single-layer
(© DSI-Thailand)

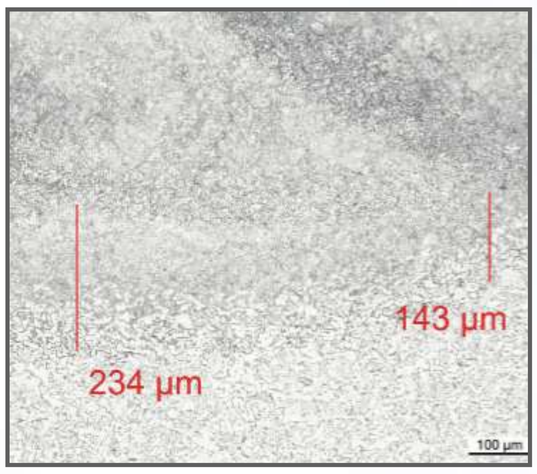


Fig. 10: Single-layer
(HAZ 0.14 mm-0.23 mm)
(© DSI-Thailand)



Fig. 11: Three-layer
(© DSIThailand)

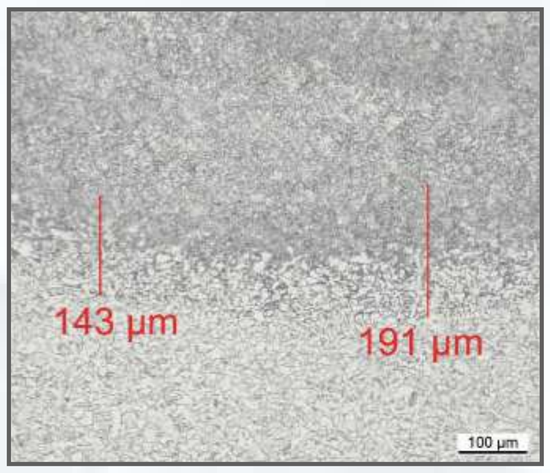


Fig.12: Three-layer
(HAZ 0.14 mm-0.19 mm)
(© DSI-Thailand)

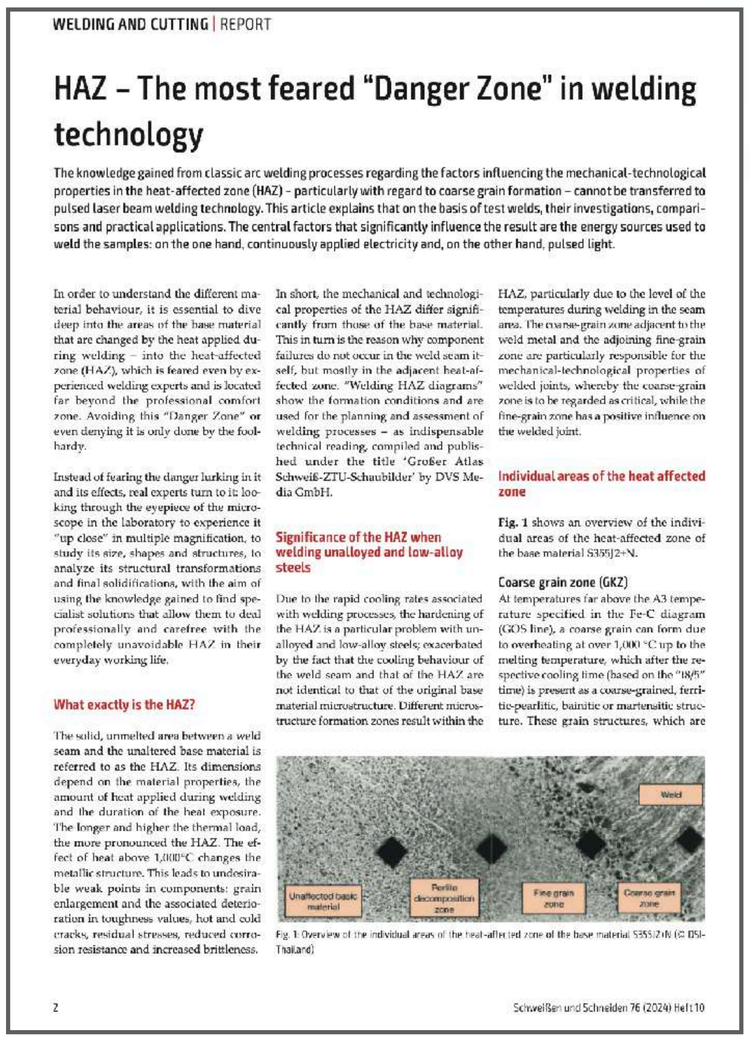
Conclusion:

The technology “***Welding with Pulsed Light and its Speed***” is able to reduce the originally high risk potential of the “danger zone” in classic welding processes using electric current as an energy source to a minimum and to harmonize between the base material and the weld metal.

The Premium Quality of Pulse Laser Welding : Investigated. Proved. Published.

The successful refurbishment of this Structural steel was published in the Magazine of German Welding Society *Welding and Cutting* (issue 2/2024)

„HAZ – The most feared “Danger Zone” in welding technology “



WELDING AND CUTTING | REPORT

HAZ – The most feared “Danger Zone” in welding technology

The knowledge gained from classic arc welding processes regarding the factors influencing the mechanical-technological properties in the heat-affected zone (HAZ) – particularly with regard to coarse grain formation – cannot be transferred to pulsed laser beam welding technology. This article explains that on the basis of test welds, their investigations, comparisons and practical applications. The central factors that significantly influence the result are the energy sources used to weld the samples: on the one hand, continuously applied electricity and, on the other hand, pulsed light.

In order to understand the different material behaviour, it is essential to dive deep into the areas of the base material that are changed by the heat applied during welding – into the heat-affected zone (HAZ), which is feared even by experienced welding experts and is located far beyond the professional comfort zone. Avoiding this “Danger Zone” or even denying it is only done by the foolhardy.

Instead of fearing the danger lurking in it and its effects, real experts turn to it looking through the eyepiece of the microscope in the laboratory to experience it “up close” in multiple magnification, to study its size, shapes and structures, to analyze its structural transformations and final solidifications, with the aim of using the knowledge gained to find specialist solutions that allow them to deal professionally and carefree with the completely unavoidable HAZ in their everyday working life.

What exactly is the HAZ?

The solid, unmelted area between a weld seam and the unaltered base material is referred to as the HAZ. Its dimensions depend on the material properties, the amount of heat applied during welding and the duration of the heat exposure. The longer and higher the thermal load, the more pronounced the HAZ. The effect of heat above 1,000 °C changes the metallic structure. This leads to undesirable weak points in components: grain enlargement and the associated deterioration in toughness values, hot and cold cracks, residual stresses, reduced corrosion resistance and increased brittleness.

In short, the mechanical and technological properties of the HAZ differ significantly from those of the base material. This in turn is the reason why component failures do not occur in the weld seam itself, but mostly in the adjacent heat-affected zone. “Welding HAZ diagrams” show the formation conditions and are used for the planning and assessment of welding processes – as indispensable technical reading, compiled and published under the title ‘Großer Atlas Schweiß-ZTU-Schaubilder’ by DVS Media GmbH.

Significance of the HAZ when welding unalloyed and low-alloy steels

Due to the rapid cooling rates associated with welding processes, the hardening of the HAZ is a particular problem with unalloyed and low-alloy steels; exacerbated by the fact that the cooling behaviour of the weld seam and that of the HAZ are not identical to that of the original base material microstructure. Different microstructure formation zones result within the HAZ, particularly due to the level of the temperatures during welding in the seam area. The coarse-grain zone adjacent to the weld metal and the adjoining fine-grain zone are particularly responsible for the mechanical-technological properties of welded joints, whereby the coarse-grain zone is to be regarded as critical, while the fine-grain zone has a positive influence on the welded joint.

Individual areas of the heat affected zone

Fig. 1 shows an overview of the individual areas of the heat-affected zone of the base material S355J2+N.

Coarse grain zone (GKZ)

At temperatures far above the A3 temperature specified in the Fe-C diagram (GOS line), a coarse grain can form due to overheating at over 1,000 °C up to the melting temperature, which after the respective cooling time (based on the “t8/5” time) is present as a coarse-grained, ferritic-pearlitic, bainitic or martensitic structure. These grain structures, which are

Fig. 1: Overview of the individual areas of the heat-affected zone of the base material S355J2+N (© DSI-Thailand)

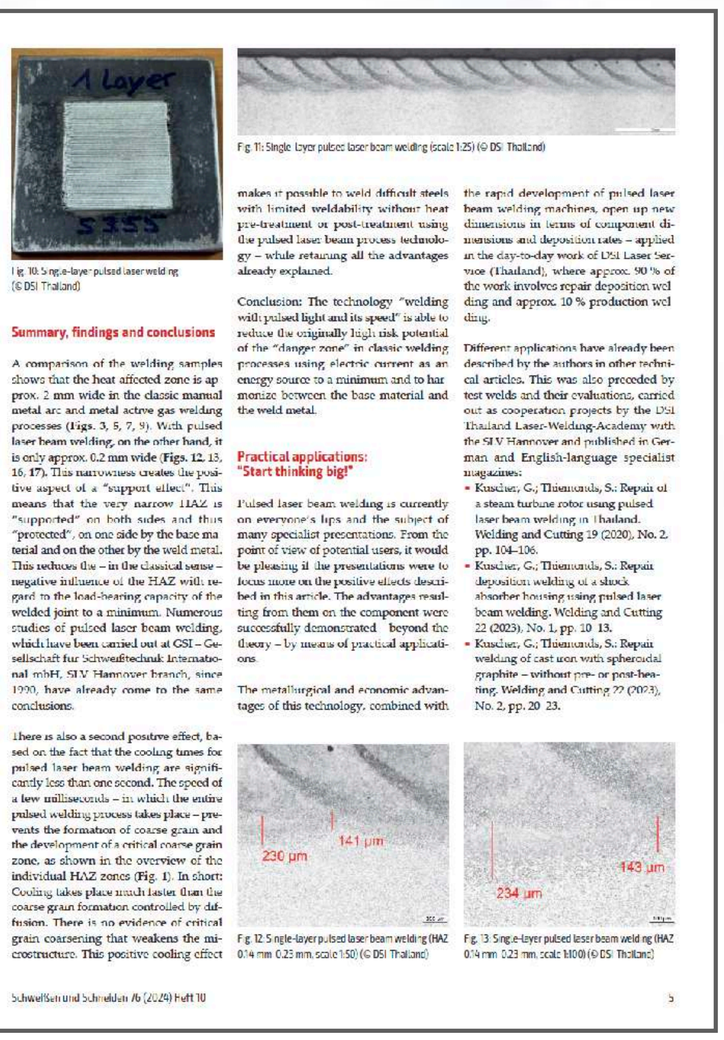


Fig. 10: Single-layer pulsed laser welding (© DSI Thailand)

Fig. 11: Single-layer pulsed laser beam welding (scale 1:25) (© DSI Thailand)

Summary, findings and conclusions

A comparison of the welding samples shows that the heat affected zone is approx. 2 mm wide in the classic manual metal arc and metal active gas welding processes (**Figs. 3, 5, 7, 9**). With pulsed laser beam welding, on the other hand, it is only approx. 0.2 mm wide (**Figs. 12, 13, 16, 17**). This narrowness creates the positive aspect of a “support effect”. This means that the very narrow HAZ is “supported” on both sides and thus “protected”, on one side by the base material and on the other by the weld metal. This reduces the – in the classical sense – negative influence of the HAZ with regard to the load-bearing capacity of the welded joint to a minimum. Numerous studies of pulsed laser beam welding, which have been carried out at GSI – Gesellschaft fur Schweißtechnik International mbH, SLV Hannover branch, since 1990, have already come to the same conclusions.

There is also a second positive effect, based on the fact that the cooling times for pulsed laser beam welding are significantly less than one second. The speed of a few milliseconds – in which the entire pulsed welding process takes place – prevents the formation of coarse grain and the development of a critical coarse grain zone, as shown in the overview of the individual HAZ zones (**Fig. 1**). In short: Cooling takes place much faster than the coarse grain formation controlled by diffusion. There is no evidence of critical grain coarsening that weakens the microstructure. This positive cooling effect makes it possible to weld difficult steels with limited weldability without heat pre-treatment or post-treatment using the pulsed laser beam process technology – while retaining all the advantages already explained.

Conclusion: The technology “welding with pulsed light and its speed” is able to reduce the originally high risk potential of the “danger zone” in classic welding processes using electric current as an energy source to a minimum and to harmonize between the base material and the weld metal.

Practical applications: “Start thinking big!”

Pulsed laser beam welding is currently on everyone’s lips and the subject of many specialist presentations. From the point of view of potential users, it would be pleasing if the presentations were to focus more on the positive effects described in this article. The advantages resulting from them on the component were successfully demonstrated beyond the theory – by means of practical applications.

The metallurgical and economic advantages of this technology, combined with the rapid development of pulsed laser beam welding machines, open up new dimensions in terms of component dimensions and deposition rates – applied in the day-to-day work of DSI Laser Service (Thailand), where approx. 90 % of the work involves repair deposition welding and approx. 10 % production welding.

Different applications have already been described by the authors in other technical articles. This was also preceded by test welds and their evaluations, carried out as cooperation projects by the DSI Thailand Laser-Welding-Academy with the SLV Hannover and published in German and English-language specialist magazines:

- Kuscher, G.; Thienmanls, S.: Repair of a steam turbine rotor using pulsed laser beam welding in Thailand. Welding and Cutting 19 (2020), No. 2, pp. 104–106.
- Kuscher, G.; Thienmanls, S.: Repair deposition welding of a shock absorber housing using pulsed laser beam welding. Welding and Cutting 22 (2023), No. 1, pp. 10–13.
- Kuscher, G.; Thienmanls, S.: Repair welding of cast iron with spheroidal graphite – without pre- or post-heating. Welding and Cutting 22 (2023), No. 2, pp. 20–23.

Fig. 12: Single-layer pulsed laser beam welding (HAZ 0.14 mm 0.23 mm, scale 1:50) (© DSI Thailand)

Fig. 13: Single-layer pulsed laser beam welding (HAZ 0.14 mm 0.23 mm, scale 1:100) (© DSI Thailand)

HAZ investigation
Article DSI-Dropbox

DSI Laser Welding

DSI Laser Wires

ALPHALASER
SOUTHEAST ASIA

DSI Service & Maintenance

DSI Laser Academy
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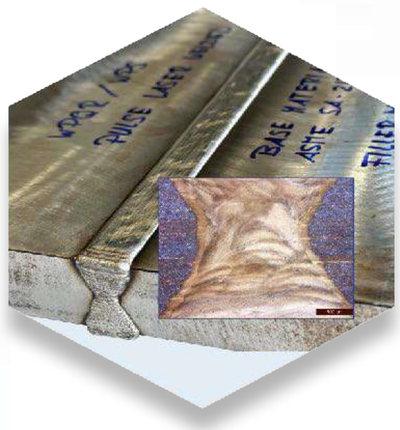
DSI Total Solution for *Pulse Laser Welding* with *DSI Laser Wires*

- *Pulse Laser Welding Service*
- *DSI Laser Welding Wires*
- *Machine processing of surfaces*
- *Authorised dealer of ALPHA LASER*
- *AL-Machines Service & Maintenance*

DSI Thailand Laser-Welding-Academy







DSI

PULSE LASER WELDING







PULSE LASER WELDING

SERVICE

DSI LASER SERVICE (THAILAND) CO.,LTD.

dsilaser.com

DSI Service & Maintenance

GERMAN TECHNOLOGY

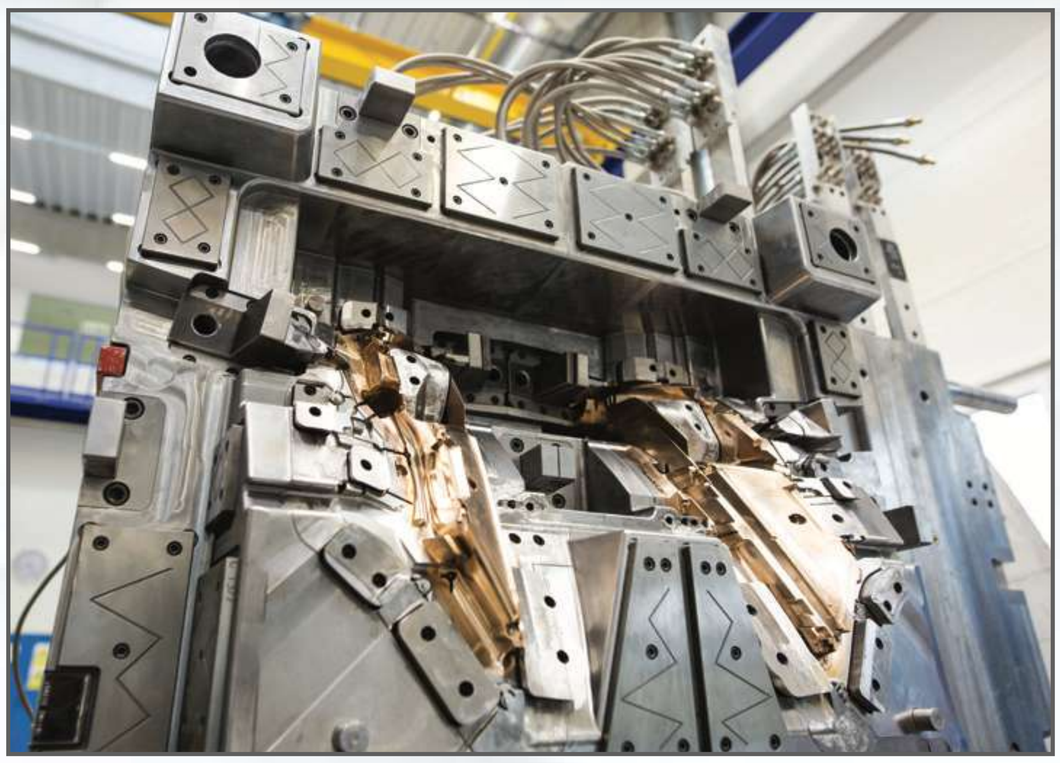
ALPHALASER SOUTHEAST ASIA

DSI
PULSE LASER WELDING

Pulse Laser Welding Service

Molds & Dies / Automotive

With **advanced Pulse Laser Welding technology**, *DSI-Thailand* create custom welding wires for every stage of Molds & Dies maintenance not just repairing, but enhancing material performance to extend the operation lifespan like never before.





Automotive car body sheet metal
PL-Mobile Welding at customers site

Problem Solutions

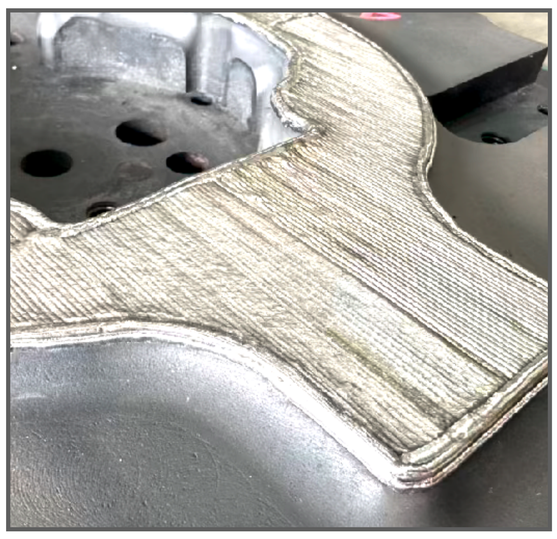
- ✓ Shape modification
- ✓ Mirror surface finishing
- ✓ Etched surface finishing
- ✓ Shape modification
- ✓ Flash removal at parting line
- ✓ Ejector pin hole repair
- ✓ Deep-area deposit welding
- ✓ Wear and scale removal / Crack repair

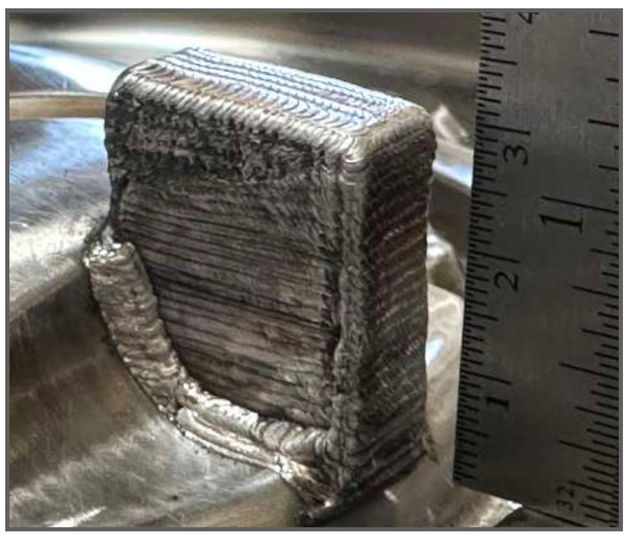
Molds & Dies Applications

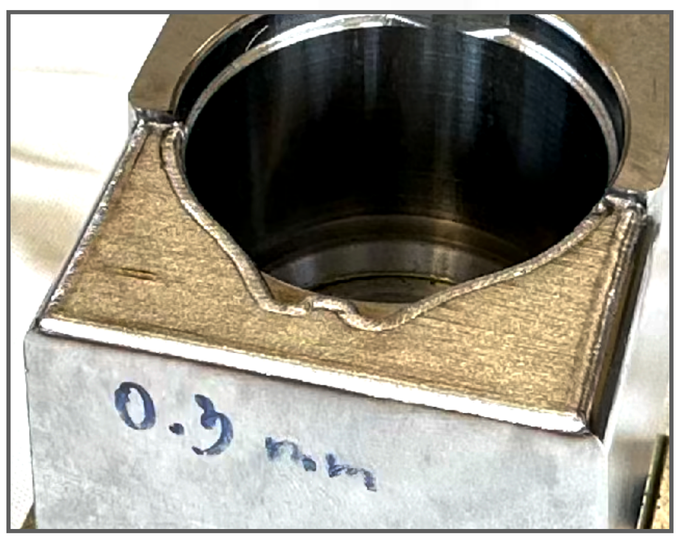
- Plastic injection molds
- Aluminum die-casting molds
- Cast iron molds / sand patterns
- Medical industrial molds
- Press dies
- Glass molds
- Hot forging dies
- Special mold components

DSI **Mobile Welding at Customers Site**

More informations → page 31







Molds & Dies
Application
Videos DSI-Dropbox

DSI
PULSE LASER WELDING

Pulse Laser Welding Service

Oil & Gas / Petrochemical / Offshore



We provide **advanced PLW-Technology** for repair components without the risks of heat-related issues such as distortion or cracking - but always full metallurgical bonding !

Equipped with **1,200** and **2,400W high-power PLW-Machines**, we can significantly reduce delivery times without compromising quality.

Premium PLW-Quality proved by **WPQR / WPS**.
Quality Control in acc. with **ISO or AWS** standards.

Advanced PLWelding for Critical Components

At DSI, we are specialised in refurbishing any challenging materials and hardfacing applications, e.g. Stellite 6/12/21; AISI 4140; Hastelloy/Hastelloy X; Duplex/Super Duplex; Cast- Grey Cast Iron. More material samples → page 16

Pulse Laser Welding : *always* **WITH** full metallurgical bonding

and *always* **WITHOUT ...**

- ✗ Pre- or post-heat treatment
- ✗ Residual stress / Distortion
- ✗ Cracks / Pores / Imperfections
- ✗ Negative effects to mechanical-technological properties

DSI **Mobile Welding at Customers Site**

More informations → page 31







Oil & Gas / Marine
Videos DSI-Dropbox

DSI
PULSE LASER WELDING

Pulse Laser Welding Service

Power Generating / Turbo Machinery

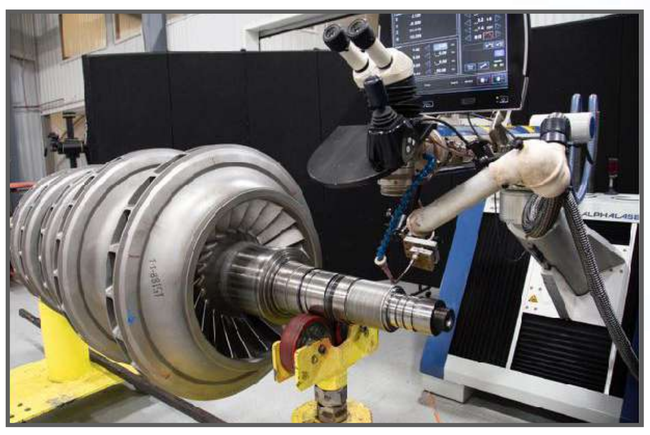
Pulse Laser Welding for refurbishing critical components ensuring precision, reliability, and national power generating security.



PLW-Processes are WPQR / WPS qualified acc. to **AWS Standard D14.6/D14.6M:2012** e.g. hight performance base materials 28CrMoNiV4-9 ASME SA217 WC6 / ASTM A387 Gr.11 / 34CrMo1A / 30CrMoNiV5.11

Perfect Solution for Power Generating applications

The refurbishment of Turbine shafts e.g. journal- and trust collar bearing and sealing positions can be done **without dismantling the turbine blades** and copper winding components in motor rotors - because Pulse Laser Welding does not require pre- or post-heat treatment. **„WHY?“** → Get the answer page 13-15.









Applications (Selection)

- ✓ Gas- & Steam Turbine Rotor Shafts
- ✓ Steam diaphragms casing
- ✓ Generator & Motor Rotor
- ✓ Turbine Casing
- ✓ Turbine Blade Tips
- ✓ Babbit Bearing
- ✓ Steam Sprint Nozzle
- ✓ Ventilation Valve Cage
- ✓ Compressor diaphragm

DSI Mobile Welding at Customers Site

More infos → page 31



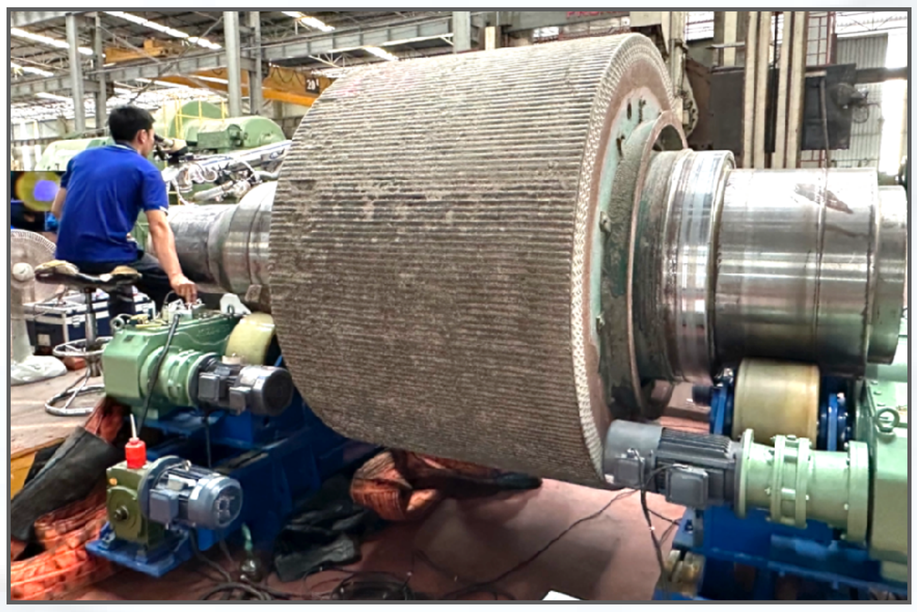
Power Generating Videos DSI-Dropbox

Turbine Shaft Repair Article DSI-Dropbox

Pulse Laser Welding Service

Heavy Industry

In the heavy industry sector, Pulse Laser Welding technology provides refurbish solutions without heat-related risks such as distortion or cracking, with fast turnaround time and always premium quality.



For non-movable components, DSI-Thailand provide **PL-Mobile-Welding at customer site**.
In our workshop we can accommodate components of up to 30 tons.



Pre- and finish machining service for PLW-surfaces are a part of **DSI-ONE-STOP SOLUTION**.

More infos → page 43-44

Pulse Laser Welding - Start thinking BIG !

AL 2400 PLW Machine provides :

Fast turn around time - very short lead time
High deposition rate
Semi-automatic PLW with continuous wire feeding



Mobile Welding at Customers Site

More infos → page 31

- ✓ Wear and tear of rotating parts
- ✓ Casing components (e.g., grey cast iron crack)
- ✓ PLWelding at any rotor shaft position e.g. bearing or oil seal
- ✓ Upgrades of challenging materials and hardfacing applications
- ✓ ***DSI Surface Engineering*** more infos → page 34





Start thinking BIG
Videos DSI-Dropbox

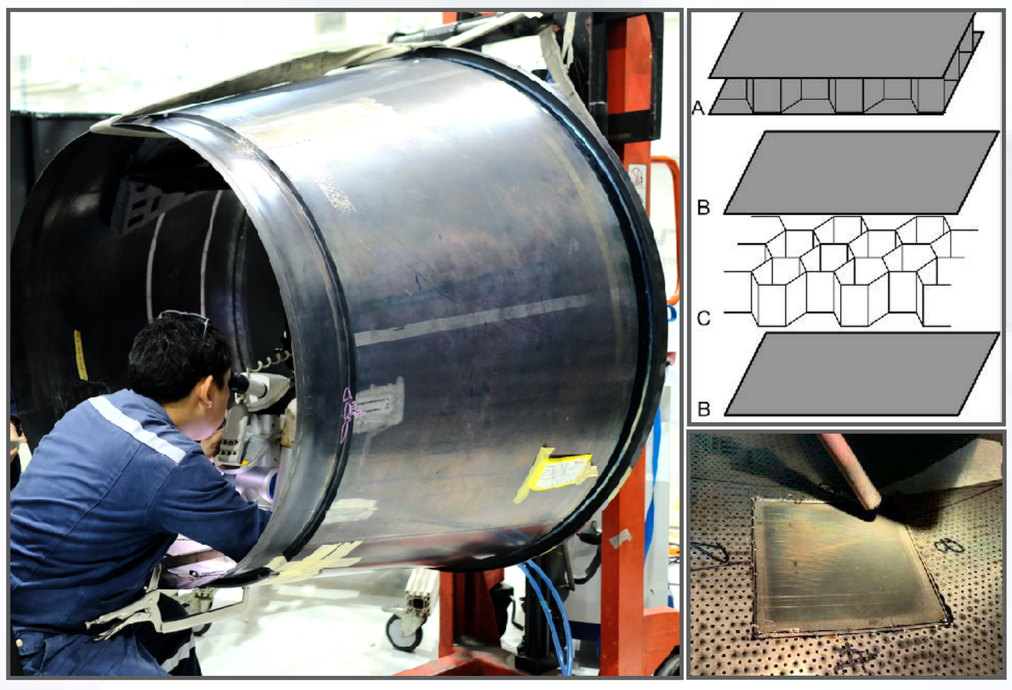
Pulse Laser Welding Service

Aerospace / Defence (MRO)



DSI-Thailand provide advanced Pulse Laser Welding for **Maintenance, Repair, Overhaul (MRO)** of critical Aircraft- Aerospace and Defence components.

PLW-Applications e.g. critical Aircraft engine components, Auxiliary power units, tooling components, aircraft structures (fuselage, wings), composition molds.



PLW-Honey-comb repair at A-Class Component

MRO Materials & Qualifications

Base Materials (Selection)

Nickel-based Alloys :

Inconel 625 / Inconel 718 / Hastelloy / Hastelloy X

Titanium Alloys :

Ti-6Al-4V (Gr.5) / Ti-6Al-2Sn-4Zr-6Mo (Beta-2IS)

Aluminium Alloys :

2024 / 6061 / 7075

Steel and high-strength steel alloys :

4340 / 300M / Maraging-Steels

DSI Mobile Welding at Customers Site

More infos → page 31

PLW for MRO
Article DSI-Dropbox

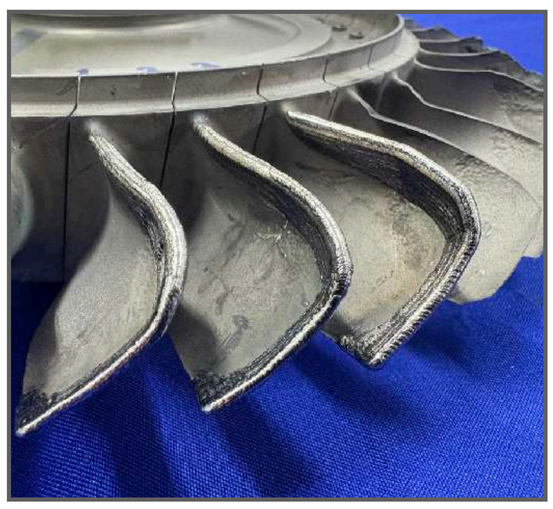
DSI-Thailand PLWelders and PLWelding Machine operators are certified acc. to two key American Welding Society (AWS) standards :

→ **AWS C7.4** – Process specification and operator qualification for laser beam welding

→ **AWS D17.1** – Specification for fusion welding for aerospace applications.

→ **DSI-Thailand Qualifications & Certifications** more infos → page 04-06









Pulse Laser Welding Service

Mobile Welding at Customers Site

The concept of **DSI TOTAL SOLUTION** includes **Pulse Laser Mobile Welding** at customer site by keep promising the premium quality of PLW-Technology and all its unique advantages → page 13.

Very quick operational readiness provided by an experienced PL-Mobile-Welding team.



Key-advantages of PL-Mobile-Welding

Effort-, Cost- & Time saving factors :

- ✓ The equipment can remain at place
  - ✗ No dismantling
  - ✗ No transportation
  - ✗ No re-assembly
- ✓ Stress-free welding process
  - ✗ No- pre- or post weld heat treatment



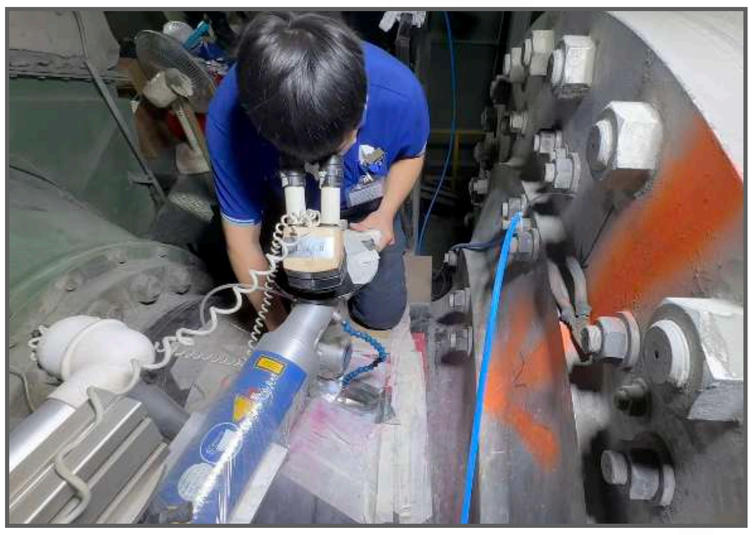
Overall no danger to the component e.g. its motor or control panels because of „*Welding with pulsed Light and its Speed*“ page → 19.

DSI Mobile Welding at Customers Site

More informations → page 31



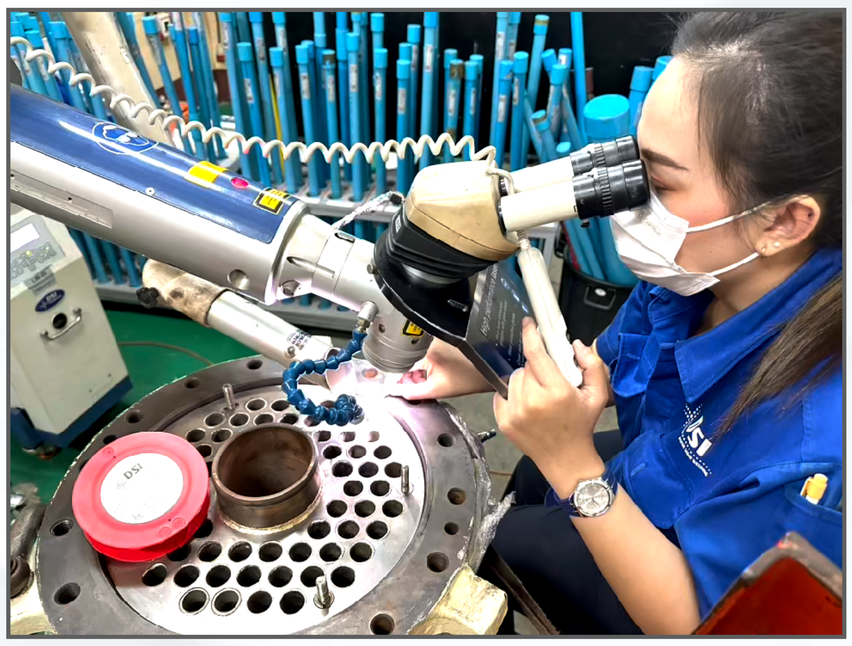




PL-Mobile-Welding
Video DSI-Dropbox

Pulse Laser Welding Service

Exotic Materials and Combinations



Good to know : The pulsed Laser can weld **ANY metal material** and can even **join very different base materials** e.g. Alu-Bronze or Tin join with Stainless Steel for Babbit Bearings.

„WHY is it possible ?“ Get the answer → page 17

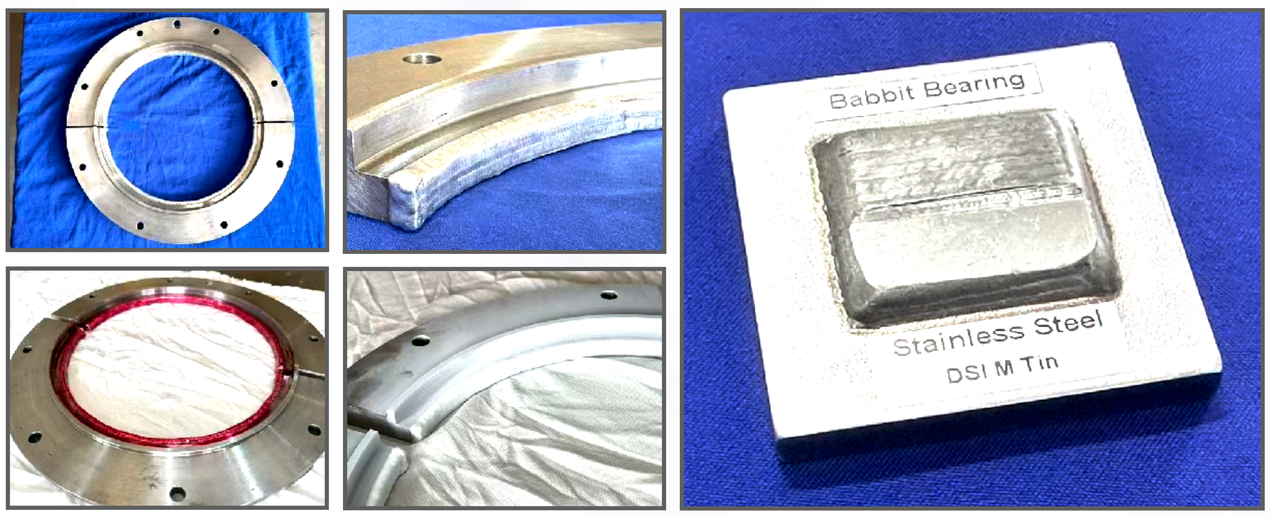
At ***DSI-Thailand-Academy*** we continuous investigate and develop this unique advantage for upgrading the performance and life time of components.
We call it : ***DSI Surface Engineering*** / get more infos → page 34.

Applications

DSI is specialise in repairing challenging materials such as Copper and Aluminium alloys, Titanium, Duplex / Super Duplex, Hastelloy X, Stelite.
Our PLW-Services are fully compliant with international welding standards e.g. ISO / AWS / ASME / JIS and premium quality proven by WPQR / WPS.

Pulse Laser Welding always provides :

- ✓ Full metallurgical bonding
- ✓ Very low heat input
- ✓ No distortion
- ✓ Very precise weld









Exotic Materials
Videos / DSI-Dropbox

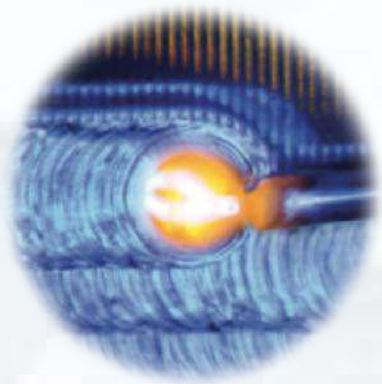
DSI
PULSE LASER WELDING

Pulse Laser Welding Service

Don’t scrap it - you can easily repair it

Thanks to **Pulse Laser Welding Technology** and its unique advantages, damaged components can be easily and quickly repaired, without compromising the premium quality - which is not possible with classical arc-welding methods. Any metal component can be easily repaired, including a very rotten gray cast iron Pump Jet Nozzle component and many other applications. **WHY** it’s possible → page 17.

Dont- scrap it applications





Broken Rotor Impeller



Cracked Screw Hole Pump Casing



Grey Cast iron Pump Jet Nozzle



Broken Flange Collar

Don’t scrap it
Videos DSI-Dropbox



Abrasion at Multi Stage Impeller



Crack Pump Casing Flange



LP Sprint Nozzle

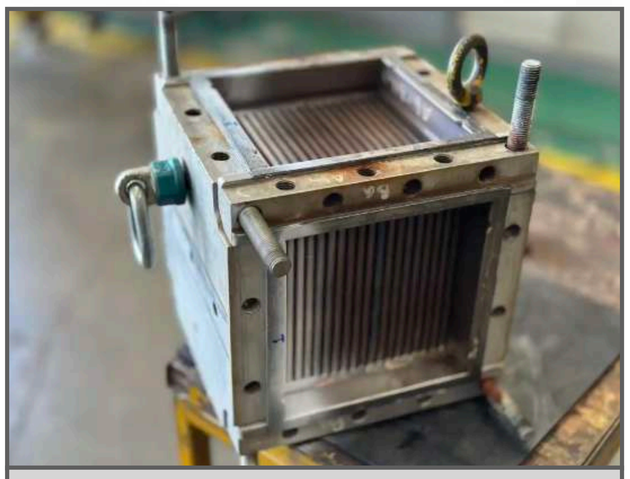


Plate Heat Exchanger

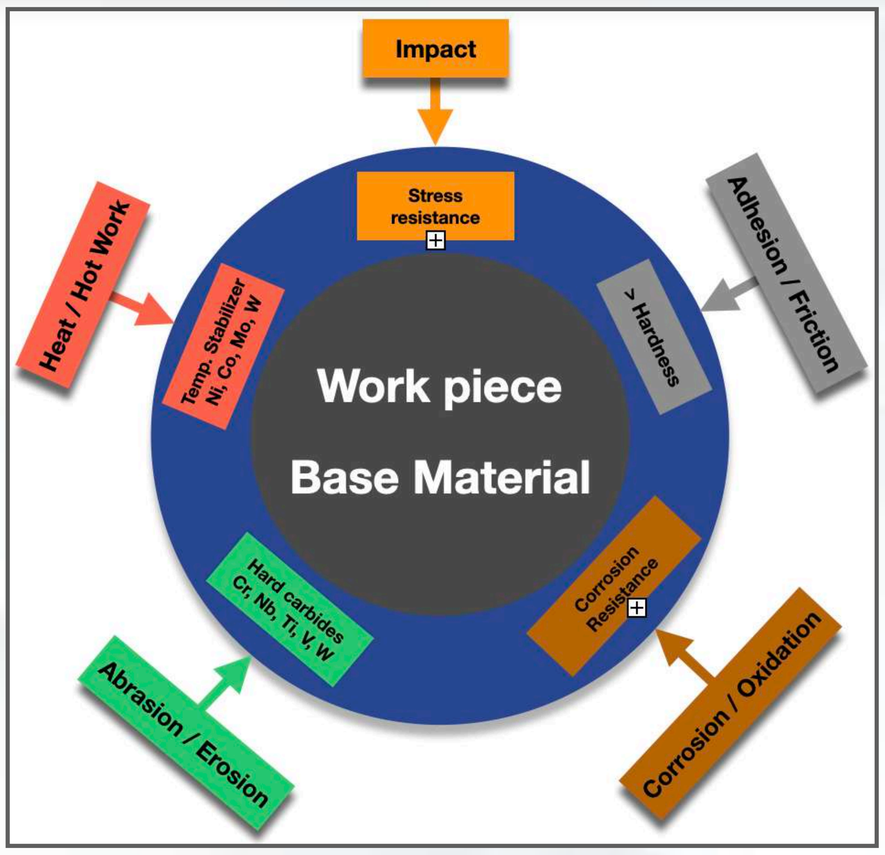
Pulse Laser Welding Service

DSI Surface Engineering

Pulse Laser Welding offers the possibility of significantly increasing the performance of components static and rotating parts by selecting a welding filler material specifically tailored to the application.

This systematic **DSI Surface Engineering** increase the operating life of the component, which in turn significantly reduces the downtime of the production plant.

In fact : **DSI Surface Engineering** is a cost-down service for customers in any industry.



HOW to select the right filler material

Performance Upgrade (Sample)

Problem :

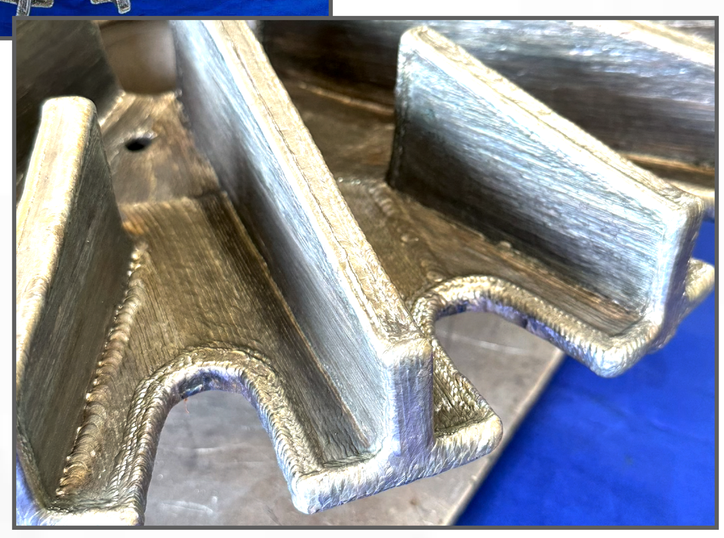
Heavy abrasion of the impeller was the cause of very short operating span and frequent pump downtime.



Base Material
Super Duplex
1.4501

Solution :

Upgrade the OEM base material SUPER DUPLEX (1.4501) by Pulse Laser Deposition Welding the whole impeller surface with filler material *DSI M ST 6* (Stellite 6) → page 41.



Advantages of PLW & *DSI M ST 6* :

Full metallurgical bonding

Crack-Free Pulse Laser Weld (Stelite 6)

Distortion free / very low heat impact during PLW.



Filler Material
DSI M ST 6
Stelite 6



WPQR / WPS Quality proved

WPQR / WPS
Article DSI-Dropbox

Impeller / Stelite 6
Video DSI-Dropbox



Good to know : both ***similar*** and ***dissimilar*** **filler materials** can be used for **DSI Surface Engineering.**

DSI

PULSE LASER WELDING







LASER WELDING WIRES

DSI LASER SERVICE (THAILAND) CO.,LTD.

dsilaser.com

MADE IN GERMANY

DVS SLV HANNOVER

INSPECTION CERTIFIED EN 10204-3.1 2005

DSI Laser Welding Wires

LASER WELDING WIRES

Committed to Quality

DSI Laser Wires are …

“The selection of the appropriate Laser Wire is a major factor to provide premium weld quality“

- Made in Germany
- Drawn-down by DSI-Thailand
- Incoming inspection by XRF (X-ray fluorescence) for to determine and confirm the elemental composition
- Randomly checks of Hardness Vickers (HV 0.3) by third party
- Available in different diameters on spools and as rods
- Vacuum packed and corrosion protected
- EN 10204 / 3.1 Quality Certified
- Obtainable for customers in whole Southeast Asia and beyond

DSI Laser Wires
Video DSI-Dropbox

25 years experience in Pulse Laser Welding

MADE IN GERMANY

DVS GERMAN WELDING SOCIETY

EN 10204 / 3.1 Quality Certified

DSI Laser Welding Wires

Applicable for any Industry

25 years experience in Pulse Laser Welding

“Trust in those Laser Wire supplier who also provides Welding Service“



- Molds & Dies
- Aerospace
- Power Generation
- Oil & Gas
- DSI Laser Wires

DSI
LASER WELDING WIRES

DSI Laser Wires - Material Groups

M & D = Required for Molds & Dies

Steel	Steel Unalloyed	DSI M 96	06
	Steel Low Alloyed	M & D DSI M 90	07
		M & D DSI M 90PK	08
		DSI M 93Plus	09
		DSI M 95Plus	10
		DSI M Connect 8	11
		DSI M Connect 9	12
	Steel High Alloyed	M & D DSI M 20	13
		M & D DSI M 20Plus	14
		M & D DSI M Connect 2	15
		DSI M 410	16
		DSI M 316L Si	17
		DSI M Connect 3	18
		DSI M Connect 3Plus	19
		DSI M Connect 4	20
		DSI M 347	21
	Steel High Alloyed Intermediate Hardfacing	DSI M Connect HF	22
		DSI M CroMan307	23
	Steel High Alloyed Hardfacing	M & D DSI M 10	24
		M & D DSI M 10Plus	25
		DSI M 50	26
		M & D DSI M 55	27
		M & D DSI M 55Plus	28
		M & D DSI M 70/12	29

MADE IN GERMANY

DVS GERMAN WELDING SOCIETY

EN 10204 / 3.1 Quality Certified

DSI
LASER WELDING WIRES

DSI Laser Wires - Material Groups

M & D = Required for Molds & Dies

Cobalt	Cobalt / Hardfacing	DSI M ST6	30
		DSI M ST12	31
		DSI M ST21	32
Nickel	Nickel-based Alloyed	DSI M NiTi3	33
		DSI M NiCr65	34
		M & D DSI M NiCr625	35
		DSI M NiCr718	36
		DSI M NiCr12/50	37
		DSI M ColMoNoy 5	38
		DSI M HasC276	39
		DSI M HasX	40
	Nickel-Copper Alloyed	DSI M NiCu70/30	41
	Nickel-Iron Alloyed	DSI M Connect 6	42
Copper	Copper Alloyed	M & D DSI M 100	43
		DSI M 120Yellow SR	44
		DSI M Ampcoloy940	45
Aluminium	Aluminium Alloyed	M & D DSI M AluCA	46
		M & D DSI M AluCF	47
		DSI M Alu99.5Ti	48
Titanium	Titanium Unalloyed	DSI M Titan Grade1	49
		DSI M Titan Grade2	50
	Titanium Alloyed	DSI M Titan Grade5	51
		DSI M Titan Grade7	52
Tin	Lead-free soft solder	DSI M Tin Sn97Cu3	53
		DSI M Tin Sn95Sb5	54

MADE IN GERMANY

DVS GERMAN WELDING SOCIETY

EN 10204 / 3.1 Quality Certified

DSI
LASER WELDING WIRES

DSI Laser Welding Wires

Applicable for any Industry





DSI M 20Plus





DSI M 70/12



DSI M 55



DSI M AluCF



DSI M 100

DSI Laser Wires
Catalog / Molds & Dies
DSI-Dropbox

DSI Laser Wires
Catalog / all Wires
DSI-Dropbox

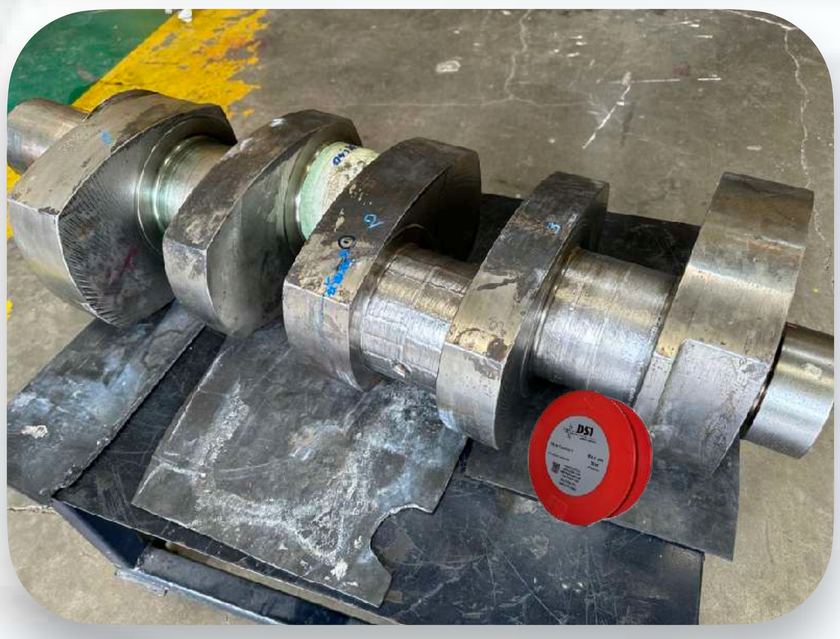
DSI
LASER WELDING WIRES

DSI Laser Welding Wires

Applicable for any Industry



DSI M 95Plus



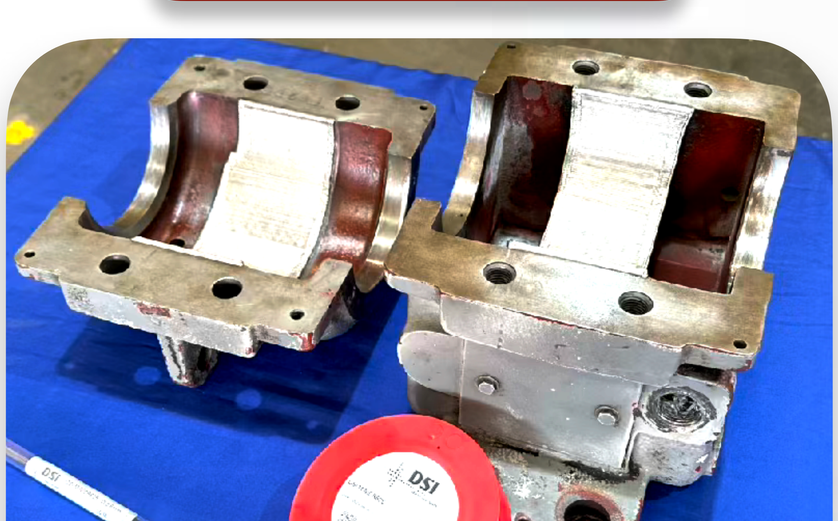
DSI M Connect 2



DSI M 10



DSI M ST6



DSI M NiCr625



DSI M NiCr625



DSI M 100

Check other DSI-Wires Applications

Exotic Materials Videos / DSI-Dropbox

Power Generating Videos DSI-Dropbox

DSI

PULSE LASER WELDING







PRE- & FINISHING OF SURFACES

MACHINE PROCESSING

DSI LASER SERVICE (THAILAND) CO.,LTD.

dsilaser.com

DSI Machine Processing

GERMAN TECHNOLOGY

ALPHALASER SOUTHEAST ASIA

DSI Laser Service (Thailand)

Machine Processing

At the **Machining Center** of *DSI Laser Service (Thailand)* we provide pre- and finishing of metal surfaces - before and after Pulse Laser Welding.

*"DSI Thailand — A **One Stop Solution** : Pulse Laser Welding & Machine Processing"*



Location :

Phu Mueng Industrial Park
Building R8
88/19 M.5 T.Muang Chonburi

Work-space
3,200 sqm

One Stop Solution

PLWelding & Machining

30 to

Crane Capacity

10 to



DSI-Machining Center
Video DSI-Dropbox

DSI
PULSE LASER WELDING

DSI Laser Service (Thailand)

Machine Processing

Machining Capacities *



Machine Type	Horizontal Lath / Weipert
Max. OD	1,000 mm
Max. Length	6,000 mm



Machine Type	Horizontal Lath / Colchester
Max. OD	500 mm
Max. Length	1,500 mm



Machine Type	Horizontal Lath / Sunmaster
Max. OD	500 mm
Max. Length	3,000 mm



Machine Type	Vertical Lath / SCHIESS
Max. OD	1,800 mm
Max. Height	1,000 mm



Machine Type	Vertical Milling / Phoeaus
Table Size	1,350 / 250 mm
Max. Height	450 mm

*** Good to know :** LARGER machine capacities are available on request.

DSI

PULSE LASER WELDING







PULSE LASER WELDING

MACHINES

DSI LASER SERVICE (THAILAND) CO.,LTD.
Authorised Dealer of ALPHA LASER

dsilaser.com

ALPHALASER

MADE IN GERMANY

ALPHALASER SOUTHEAST ASIA

ALPHALASER

SOUTHEAST ASIA



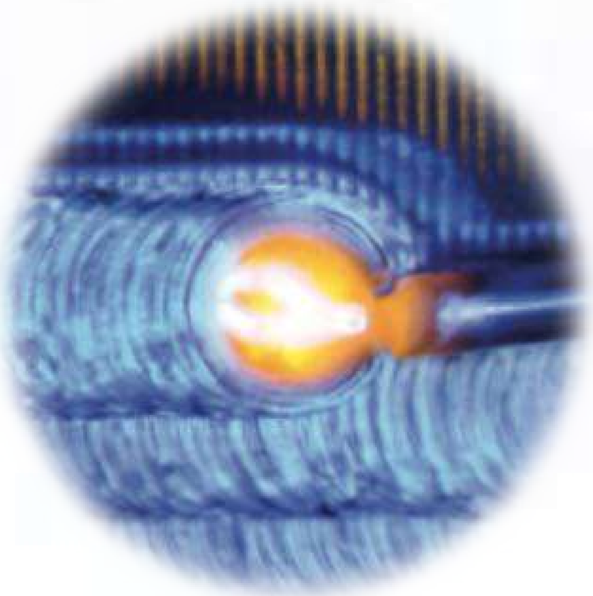
VLO SERIES



AL SERIES



ALM SERIES





AL-IN SERIES



ALV SERIES



ALO SERIES



AL-*FLAK* SERIES

AL-Machines
DSI-Catalog

Pulse Laser Welding

ALPHA LASER Systems

At ***DSI Laser Service (Thailand)*** together with ***ALPHA LASER SEA***, we are dedicated to delivering exceptional results through our advanced laser systems. For us, it's more than just supplying top-tier machines we provide complete technology solutions, comprehensive knowledge transfer and outstanding after-sales support for the entire service life.

ALPHA LASER Systems are engineered to be …

AL-Machines
Video DSI-Dropbox

- **Powerful** – delivering strength precision your applications demand
- **Reliable** – ensuring consistent, high-quality performance every time
- **Easy to Use** – simplicity, efficiency, and operator comfort
- **Durable** – a safe and lasting investment for develop your business
- **Versatile** – mobile, robust, and adaptable to a wide range

From delicate precision components to heavy industrial equipment, our individual customer specified solutions cover the full spectrum of Pulse Laser Welding needs.
With decades of expertise, we offer proven systems, including our unmatched Pulse Laser Welding technology.

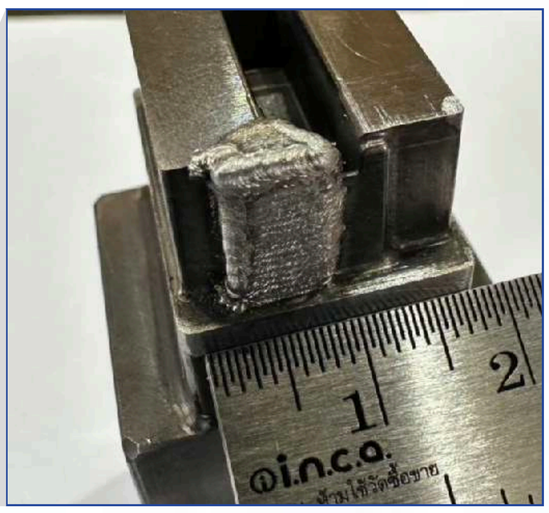
Pulse Laser Welding

Continuous Development

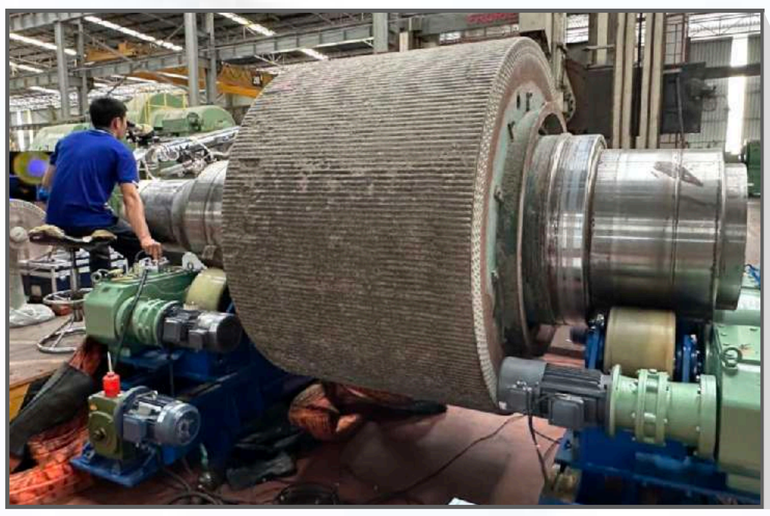
Pulse Laser Welding Technology is already available for **more than 30 years**. Based on the foundation of ALPHA LASER GmbH in 1994. Because of its unique advantages, PLW provides (almost) unlimited applications. Meanwhile successfully applied in any industry.

But **WHY** is it possible - **only since few years** - to think economically BIG ?

PLW *small* Videos DSI-Dropbox



Keep thinking ***small***



Start thinking ***BIG***

PLW *BIG* Videos DSI-Dropbox



Good to know : Since 1995 - when ALPHA LASER released the first PLW-Machine ALS 25 - until nowadays the Technology itself hasn't changed - it was and it is all about Pulse Laser Welding. The only one what have changed is the Pulse Power and therefore the deposition rate and therefore the welding speed.

Pulse Laser Welding

Trust but Verify - Laser Power

The premium quality of a pulsed laser weld is related to many factors. One important criteria is the Laser Power [W] - which is not the number of Laser Power displayed on the Laser Machine or at its data sheet. In fact it's the **Laser Power provided at the surface of the work piece** when it get welded.

Therefore „**Trust** the designated Laser Power **but Verify** it" - confirmed by a calibrated Pulse Laser Power probe.

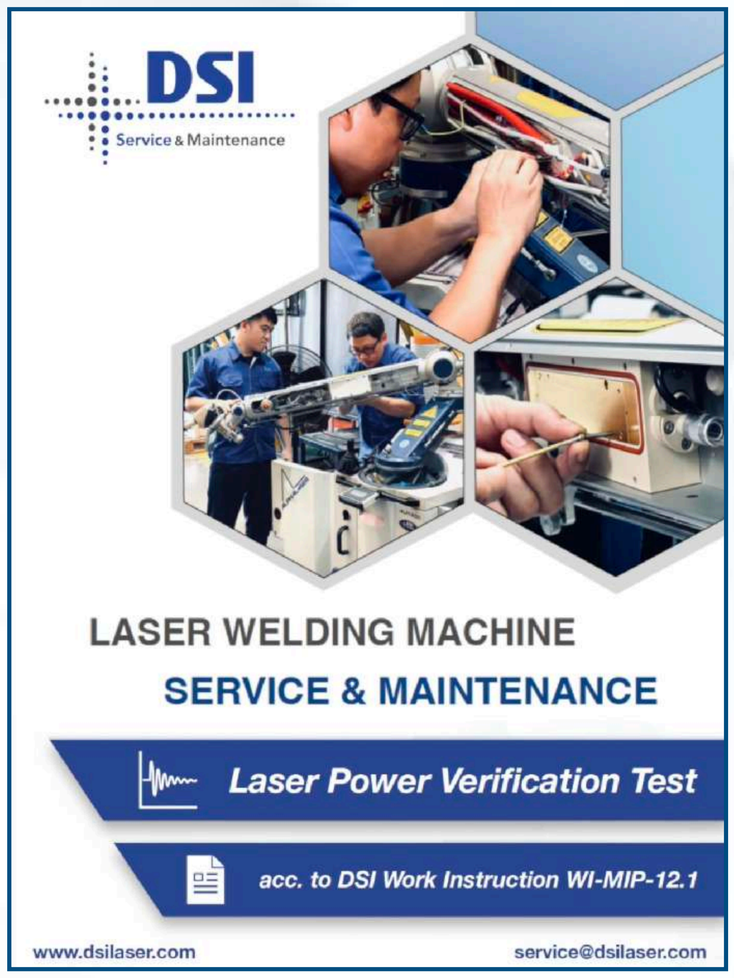
At DSI-Thailand we carry out the Power Verification Test in accordance with our *DSI Work Instruction „WI MIP-12.1"*.



AL-IN 150 Laser Power verified



ALFlak1200F Laser Power verified



Pulse Power Verify
Video DSI-Dropbox

ALPHA LASER's quality promise:

AL-machines provides the Laser Power which is displayed on their cover and in the data sheets - at least 100% of the promised Laser Power - but usually even a few percent more.

Good to know : Pulse Laser Welding Technology uses two different Pulse Power sources, provided by solid-state lasers. One is „created" by ***Nd:YAG*** (1064nm) which is an infrared radiation from a ***N***eodymium-***d***oped ***Y***ttrium ***A***luminum ***G***arnet crystal. The other one is „created" by a ***Fiber*** (1070nm) whereby the energy is transmitted via a flexible optical fiber glass.

While the Laser Power of fiber laser machines remains always stable and consistent, the Laser Power of Nd:YAG lasers decreases over time, due to factors such as flash lamp degradation. It can be compensated by adjusting the parameters.

DSI

PULSE LASER WELDING



PULSE LASER MACHINE

SERVICE & MAINTENANCE

DSI LASER SERVICE (THAILAND) CO.,LTD.

dsilaser.com

DSI Service & Maintenance

GERMAN TECHNOLOGY

ALPHALASER SOUTHEAST ASIA

PULSE LASER MACHINE

SERVICE & MAINTENANCE

- INSTALLATION AND COMMISSIONING
- REPAIR AND OVERHAUL
- ROOT CAUSE ANALYSIS
- PREVENTIVE MAINTENANCE PROGRAM
- ALPHA LASER SPARE PARTS ON STOCK
- MACHINE OPERATION TRAINING

"Our team is ready to service customers in Thailand and whole Southeast Asia."

DSI Total Solution for ***Pulse Laser Welding*** with ***DSI Laser Wires***

DSI Service & Maintenance

GERMAN TECHNOLOGY

ALPHALASER SOUTHEAST ASIA

ALPHALASER
SOUTHEAST ASIA

DSI Total Solution

AL-Machines Service & Maintenance

✅ Genuine Spare Parts from the OEM Manufacturer

In collaboration with **ALPHA LASER GmbH**, we ensure high-quality service and genuine parts according European standards.

🇹🇭 Spare Parts on stock in Thailand

Comprehensive Machine Maintenance Services100% of consumable parts and 90% of machine parts are stocked locally for fast delivery and support. More infos → page 55.

🛡️ Preventive Maintenance Program

Minimize downtime with tailored maintenance plans following industry standards. More infos → page 54.

🔍 Holistic Monitoring System

An integrated system covering every step:

- Installation: Site survey & risk assessment
- Inspection: Machine performance
- Repair: Root cause analysis & problem reports
- In interaction with Alpha Laser Germany provide the best recommendation for customers

DSI Service & Maintenance
Video DSI-Homepage

ALPHALASER
SOUTHEAST ASIA

DSI Total Solution

AL-Machines Service & Maintenance

Why schedule Preventive Maintenance (PM) for your laser welding machine?

✅ **Reduce Downtime**

90% of machine issues come from poor maintenance

✅ **Lower Risk of Failure**

Prevents poor weld quality, porosity, and incomplete fusion due to machine errors.

✅ **Boost Efficiency**

Proper PM = Higher precise output.

✅ **Enhance Safety**

Safety checks follow **DGUV Regulation 11**



📦 **What the PM Package includes :**

	Service	Frequency	Included
✅	Machine preventive maintenance, alignment & inspection	4 times / year	✓
✅	Resonator system inspection & alignment	Included	✓
✅	Cooling system check, cleaning & fluid replacement	Included	✓
✅	Electronic system inspection	Included	✓
✅	Laser output power calibration	4 times / year	✓

💡 **Premium Support - All Inclusive**

	Support Package	Duration	Included
✅	Free machine check & repair service	1 year	✓
✅	Free on-site welding technical advice	1 year	✓
✅	Re-training course	1 time / year	✓

ALPHALASER
SOUTHEAST ASIA

DSI Total Solution

AL-Machines Preventive Maintenance

Preventive Maintenance (PM) for Pulse Laser Welding Machines

“International standards for the continuity of your production"

- ✅ DSI expert team specialized in AL Pulse Laser welding machines
- ✅ On-site Service at your workshop
- ✅ Inspection & maintenance following OEM Protocol
- ✅ Transparent reporting with full measurement data







Our Service Process

➜ Inspection based on OEM Standard Checklist
- Measurement of all critical points (laser power & electrical systems)

➜ Cleaning and Preventive Maintenance
- Fine-tuning for peak machine performance

➜ Detailed Inspection Report
- With recommendations for operation



ALM200 / PM
Video DSI-Dropbox

ALPHALASER
SOUTHEAST ASIA

DSI Total Solution

Spare Parts for AL-Machines

"OEM Spare Parts · Local Stock · Global Standards

Ensuring Seamless Production"

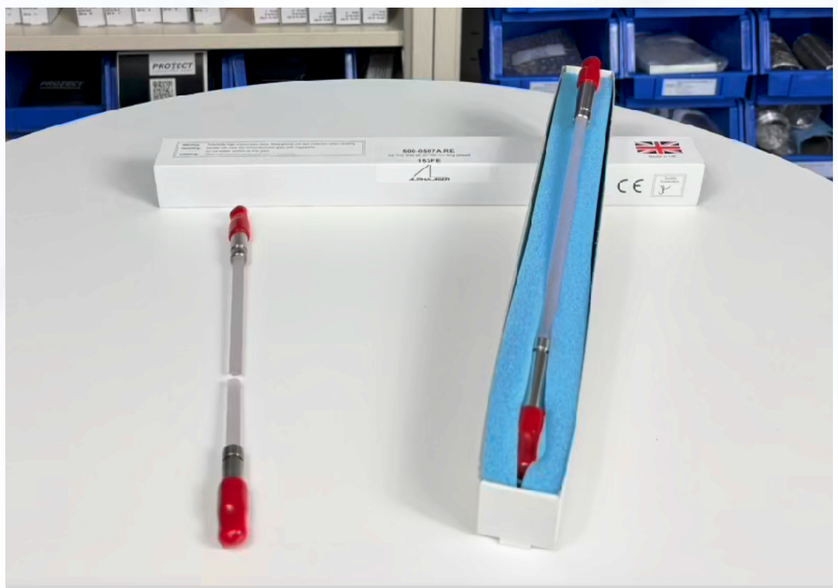
🇹🇭 Spare Parts Stock in Thailand

- 100% consumable parts and 90% machine parts in stock
- Local warehouse for **fast delivery** and **immediate support**
- Covering full maintenance and repair services



✅ Guaranteed OEM Spare Parts

- 👍 Genuine spare parts from **ALPHA LASER**
- 👍 Certified quality under European standards
- 👍 Extend machine lifetime reduce downtime



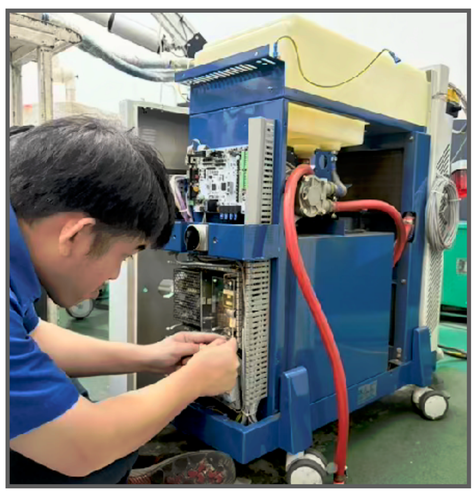
ALPHA LASER spare part -
Nd:YAG Rod

Change broken
Nd:YAG Rod
Video DSI-Dropbox

🔧 Comprehensive Machine Maintenance Services

- Scheduled inspection & replacement
- On-site service by expert technicians









DSI Total Solution

Installation. Commissioning. Training

As a part of **DSI Total Solution**, *DSI-Thailand* provides, together with *ALPHA LASER Southeast Asia* & *DSI Thailand Laser-Welding-Academy* after sales service:

Installation / Commissioning / Training for AL-Machines. For customers in Thailand, in whole Southeast Asia and sometimes beyond e.g. in Japan, New Zealand, Egypt …



AL500CWS
New Zealand
Installation



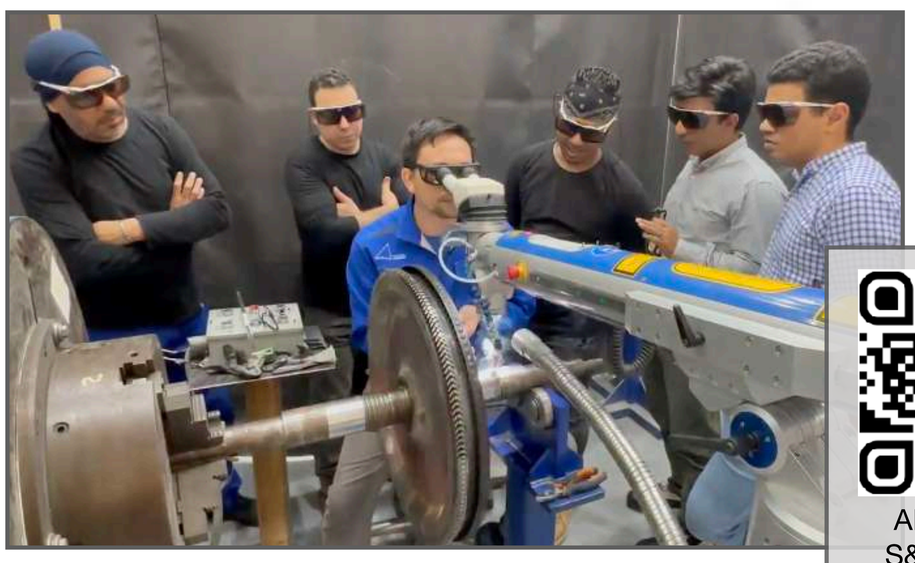
AL200CWS
Commissioning
New Zealand



ALFlak300F
Commissioning
Egypt



ALFlak300F
PLWelder Training
Egypt



ALFlak300F
S&M Training
Egypt

DSI Total Solution for ***Pulse Laser Welding*** with ***DSI Laser Wires***

More infos → page 24.

DSI Laser Academy

Powered by DVS SLV HANNOVER







PULSE LASER WELDING ACADEMY

DSI LASER SERVICE (THAILAND) CO.,LTD.

dsilaser.com

DSI PULSE LASER WELDING

DVS ZERT ISO 3834-2:2021

ALPHALASER SOUTHEAST ASIA

PULSE LASER WELDING
ACADEMY

EDUCATION

MODULE 1: Laser safety regulation

MODULE 2: Machine operation

MODULE 3: Introduction to welding operation

MODULE 4: Training for welder certification

MODULE 5: Training for welder in Aviation & Aerospace

CERTIFICATION

DIN EN ISO 14732:2013-12

AWS C7.4/C7.4M:2017

AWS D14.6/D14.6M:2012

AWS D17.1/D17.1M:2017

ENGINEERING SUPPORT

Welding procedure development (WPS / WPQR)

DSI Total Solution for ***Pulse Laser Welding*** with ***DSI Laser Wires***

DSI Laser Academy
Powered by DVS SLV HANNOVER

ALPHALASER SOUTHEAST ASIA

dsilaser.com

DSI Thailand Laser-Welding-Academy

Collaborations

A designated objective of ***DSI Thailand Laser-Welding-Academy*** is a continuous development of Pulse Laser Welding Technology for customers in any industry, which is accompanying with a deeper and wider understanding regarding base- and filler-materials, individual applications and required component performances.

This **Vision & Mission** is based on several strong and solid collaborations with international institutes, third parties and societies who have a deep and wide understanding within the world of welding.

"A strong collaboration of professional parties is the key of success"

Together we offer and carry out :

Investigations - Examinations - Certifications - Publications

DSI Thailand Laser-Welding-Academy

Education & Certification

In cooperation with German Welding Society *DVS SLV Hannover*, *DSI Thailand Laser-Welding-Academy* is permitted to educate and qualified Pulse Laser Welders and Pulse Laser Welding Machine Operators. Both DSI-Employees and also Customers wo operate with *ALPHA LASER* Systems.

SLV HANNOVER

Certificate of Appreciation

the

DSI Thailand Laser-Welding-Academy

as a cooperation of

DSI Laser Service (Thailand) Co., Ltd.

and

Schweißtechnische Lehr- und Versuchsanstalt (SLV) Hannover

is recognized as the first professional institution for the education and qualification of laser welders according to the training and examination guideline SLV-H-LS01.

Valid for Thailand, the entire Southeast Asian territory
and beyond for Asia Pacific (New Zealand and Australia).

Hannover, Februar 2020

Prof. Dr.-Ing. Gerd Kuscher
Leitender Auditor und Zertifizierer

GSI – Gesellschaft für Schweißtechnik International mbH, Niederlassung SLV Hannover • Am Lindener Hafen 1, 30453 Hannover • www.slv-hannover.de

Laser Academy

Powered by DVS SLV HANNOVER

DSI Thailand Laser-Welding-Academy

Education & Certification

Approval Test Certificate of „*Pulse Laser Welder*“ and „*Pulse Laser Welding Machine Operator*“, executed by *DSI Thailand Laser-Welding-Academy* based on the approval of German Welding Society *DVS SLV Hannover.*

1 Approval test certificate for welding operators or weld setters

2 Page:	1 of 1	Examining body:	GSI mbH, NL SLV Hannover
3 Manufacturer`s welding procedure specification:	DSI Laser Service Thailand Co	Test No.:	2022669069 - 000001
4 Reference No. (if applicable):	pWPQ-2.4819-1200-DSI		
5 Name of welding operator or weld setter:	**Banpao, Cherdchai**		
6 Identification:	1-5503-00022-79-8	Photo	
7 Method of identifiaction:	-	(if required)	
8 Date and place of birth:	1987-05-22, NAN		
9 Employer:	DSI Laser Service Thailand Co. Ltd.		
10 Code / testing standard:	ISO 14732:2013-12		
11 Job knowledge:	bestanden		

12 Weld details	Test piece:	Range of qualification
13 Welding process:	521	521
14 Welding equipment:	Nd: YAG pulse laser welding machine	Nd: YAG pulse laser welding machine
15 Welding unit:		
16 **Details for mechanized welding**		
17 Visual control / visual remote control:	Visual Control	Visual Control
18 Arc sensor control:	-	-
19 Automatic joint tracking:	-	-
20 Welding position:	PA	PA
21 Single run / multi run:	multi run per side technique	multi- and single run per side technique
22 Material backing:	-	-
23 Consumable insert:	-	-

24 **The qualification is based on:**

25 - Welding procedure test (see 4.1a)	☒
26 - Pre-production welding test (see 4.1b)	☐
27 - Standard test piece (see 4.1c)	☐
28 - Production test or production sample testing (see 4.1d)	☐

29 **Result of the qualification test see document No.:**
30 (Welding procedure qualification record or other documents of testing)
31
32

GSI mbH · SLV Hannover · GSI SLV · 8 · anerkannte Stelle

Prolongation acc.: 5.3 a
Place: Hannover
Date of welding: 14.11.2022
Valid until: **13.11.2028**

33 **Remarks:**

Dr. Kuscher

Dr.-Ing. G. Kuscher
Name and signature of examiner or examining body

34

35 **Confirmation of the validity by welding coordinator or**
36 **examiner or examining body for the following next 6 month (Clause 5.2)***

37

Date	Signature	Position or title

Date	Signature	Position or title

38 * Append separate sheet if required
39 **Translation and further information on the back**

PLW-Certification for DSI-internal Video DSI-Dropbox

PLW-Certification for Customer Video DSI-Dropbox

DSI Laser Academy

Powered by DVS SLV HANNOVER

DSI Thailand Laser-Welding-Academy

Education & Certification

DSI Laser Academy

Powered by DVS SLV HANNOVER

CERTIFICATE OF ATTENDANCE

Laser Safety Regulation “DGUV Vorschrift 11” (Former “BGVB2”)

CHERDCHAI BANPAO

DSI LASER SERVICE (THAILAND) CO.,LTD.

January 2025 - December 2027

Stephan Thiemonds

Principal

Registed number DSIAC-DGUV-1/25-12/27

DSI Laser Service (Thailand) Co.,Ltd.

Safety Training
BOSCH TH
Video DSI-Dropbox

DSI Laser Academy

Powered by DVS SLV HANNOVER

CERTIFICATE OF ATTENDANCE

Basic practical Pulse Laser Welding “DSI Welder 5”

CHERDCHAI SUESAT

DSI LASER SERVICE (THAILAND) CO.,LTD.

January 2025 - December 2027

Stephan Thiemonds

Principal

Registed number DSIAC-DGUV-1/25-12/27

DSI Laser Service (Thailand) Co.,Ltd.

PLW-Training
EGAT TH
Video DSI-Dropbox



DSI Laser Academy
Powered by DVS SLV HANNOVER

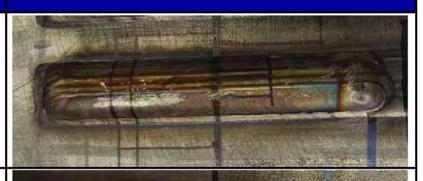
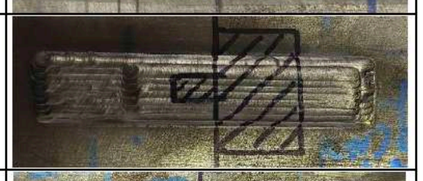
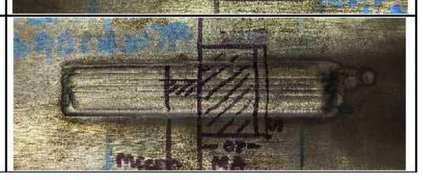
KMUTT King Mongkut's University of Technology Thonburi

Final official progress presentation at KMUTT
Date : 5th March 2025

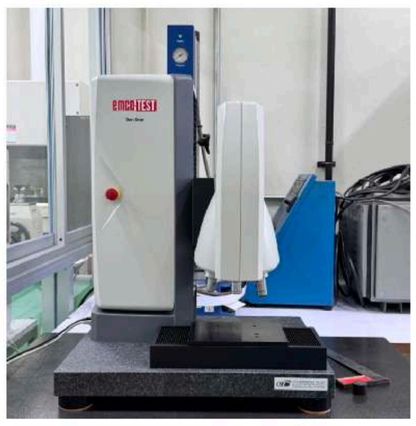
Development and evaluation of Pulsed Laser Welding of Cast iron without Preheat – Post weld heat treatment

1. Experimental welding process with Pulsed Laser Welding.

After experiment set-up, we proceeded to the welding.

Conditions	Welding Filler metal				Weld bead appearance (After weld)
	Weld layer 1st		Weld layer 2nd		
	Filler metal	Dimeter (mm)	Filler metal	Dimeter (mm)	
4	Inconel625 (1,200-watt laser welding machine)	1.2	M90 (2,400-watt laser welding machine)	1.6	
5	Inconel625 (1,200-watt laser welding machine)	1.6	M90 (1,200-watt laser welding machine)	1.6	
6	Inconel625 (1,200-watt laser welding machine)	1.6	M90 (Hot Wire feed, 1,200-watt laser welding machine)	1.6	

4. Investigation of Mechanical Properties Affecting Hardness Characteristics. [7]



Hardness tester Machine

Remark : In hardness testing, a minimum spacing of 2.5 times the diagonal length of the indentation shall be maintained from the previous test location in both the X and Y axes.

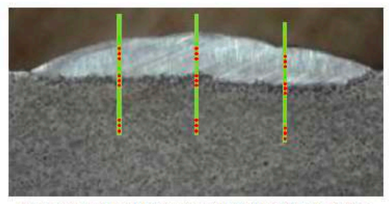
[7] https://www.worldoftest.com/th/vickers-hardness-test-method

❑ **Mechanical Analysis**

- Vickers Hardness test (follow : ASTM E384-17 Standard Test Method for Microindentation Hardness of Materials)

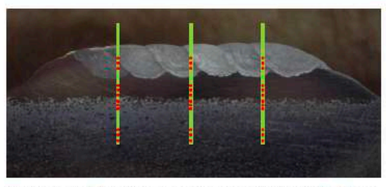
❑ **Set up Hardness test**

1. Single layer



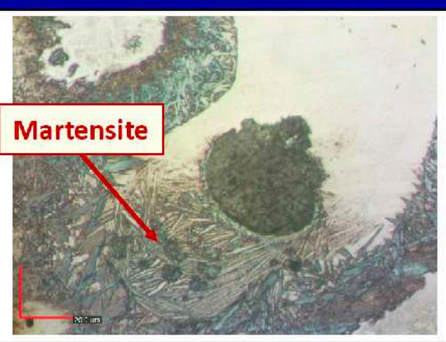
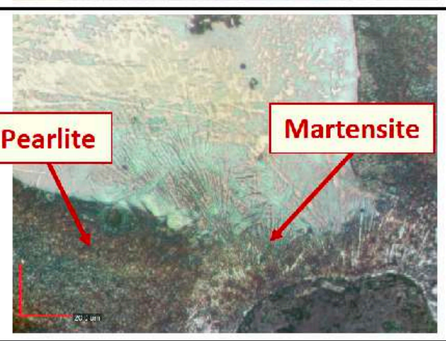
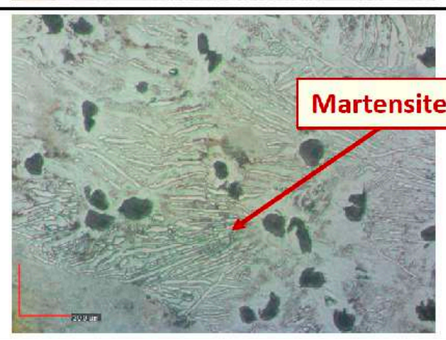
Mapping of hardness test point of Single layer

2. Multiple layer



Mapping of hardness test point of Multiple layer

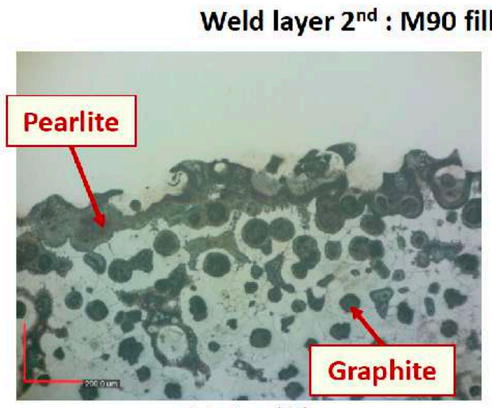
Results Microstructural Result of Pulse laser welding and Shielded metal arc welding [6]

	Pulse laser welding	Shielded metal arc welding
Single layer welding		
Multiple layer welding		

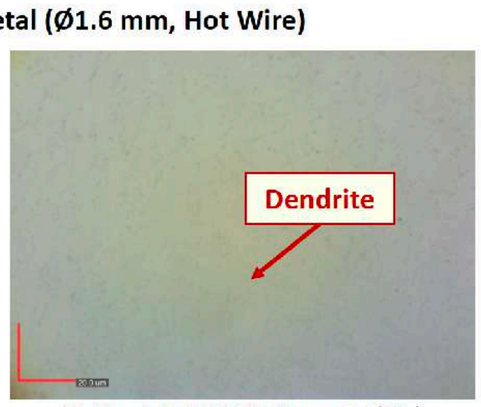
[6] Jacek Tomków, Grzegorz Rogalski, Dariusz Fydrych, Jerzy Łabanowski. (2019). *Advantages of the Application of the Temper Bead Welding Technique During Wet Welding*. Retrieved October 10, 2024, from https://www.mdpi.com/1996-1944/12/6/915

Results Microstructural Result of Pulse laser welding

- Condition 6 : Weld layer 1st : INCR625 filler metal (Ø1.6 mm)
  Weld layer 2nd : M90 filler metal (Ø1.6 mm, Hot Wire)



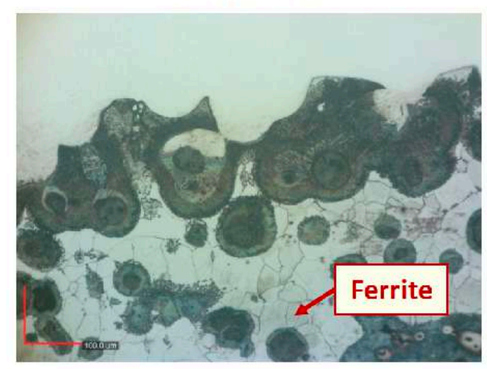
Interface (5x)



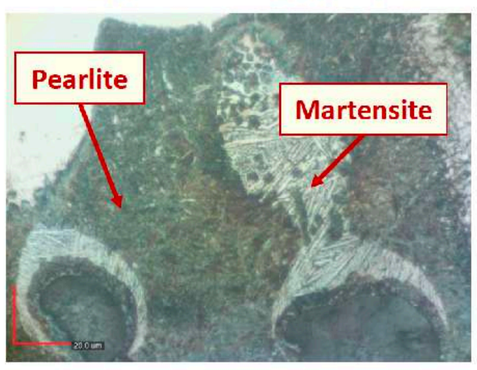
Weld metal - INCR625 filler metal (50x)



Weld metal – M90 filler metal (10)



HAZ (10x)



HAZ (50x)


Interface - INCR623 and M90 (10x)

Results Macrostructural of Pulsed laser welding

- Macrostructural Result

Conditions	Welding Filler metal				Macrostructural	Result	
	Weld layer 1st		Weld layer 2nd				
	Filler metal	Dimeter (mm)	Filler metal	Dimeter (mm)			
1	Inconel625 (1,200-watt laser welding machine)	1.2	-	-		Max depth of penetration (mm): 0.54; Width of HAZ (mm): 0.41; Complete fusion without welding discontinuities (such as cracks or porosity)	
2	Inconel625 (1,200-watt laser welding machine)	1.2	M90 (1,200-watt laser welding machine)	1.6		Max depth of penetration (mm): 0.44; Width of HAZ (mm): 0.51; Complete fusion without welding discontinuities (such as cracks or porosity)	

Project Presentation Students of KMUTT Video DSI-Dropbox

PLW of spheroidal Cast Iron Without pre- or post heat treatment Article DSI-Dropbox

Technical Articles

Published in international welding magazines, written in English and German Language

- *Repair of a steam turbine in Thailand using pulsed laser beam welding (in Welding and Cutting, issue 2/2020)*
- *Pulsed Laser Beam Welding – start thinking big! Repair welding of a shock absorber housing (Welding and Cutting, issue 1/2023)*
- *Repair welding of spheroidal graphite cast iron – Problem-free without heat pre-treatment and post-treatment (in Welding and Cutting, issue 2/2023)*
- *Pulsed Laser Welding – High above the clouds of Thailand, (Welding and Cutting, Ausgabe 1/2024)*
- *HAZ – The most feared Danger Zone in welding technology, (Welding and Cutting, issue 2/2024)*
- *Pulse Laser Welding Development: Back then it has started with thinking small – now it's time to start thinking BIG!, (Indias Welding Magazine Weldfab Tech Times, issue 10/11. 2024)*
- *Pulsed Laser Beam Welding Leads the Race - Refurbishment of the Eroded Outlet Nozzle of a Recyled Gas Compressor Housing, (Welding and Cutting, issue 2/2025)*
- *Development of Pulse Laser Welding of Cast Iron without pre- and post heat treatment, (Welding and Cutting, issue 1/2026)*

Magazine, Handbook, Catalog (regular / annual updates)

- *DSI Thailand Pulse Laser Welding Handbook (issue 10/2025)*
- *DSI Thailand Laser-Welding-Academy Magazine, (issue 11/2024)*
- *DSI Thailand Laser Welding Wires, (issue 04/2025)*
- *DSI Thailand Laser Welding Wires / Molds & Dies (issue 05/2025)*
- *DSI Thailand Pulse Laser Welding Machines, (issue 08/2025)*

Books

- *Welding Connects - You'll Never Work Alone, DVS-Media, 2023, 408 p., ISBN: 978-3-96144-197-6*
- *Schweißen Verbindet - You'll Never Work Alone, DVS-Media, 2020, 328 p., ISBN: 978-3-96144-078-8*













Pulse Laser Welding

Global Team



Globally united by the same technology & spirit :

„*Pulse Laser Welding Connects*“

Germany

Alpha Laser GmbH
Pucheim, Bavaria
Mr. Oliver Lochozki
www.alphalaser.de

DVS SLV Hannover
Prof. Dr.-Ing. G. Kuscher
www.slv-hannover.de

Thailand

DSI Laser Service (Thailand) Co., Ltd.
Chonburi (Head office)
Ms. Thongplew Banpao
www.dsilaser.com

Japan

DKN Laser Welding Co., Ltd.
Mr. Toshihiko Koga
Utsunomiya, Tochigi
www.dknlaser.co.jp

USA

Phoenix Laser Solution
Meadville, Pennsylvania
Mr. Chris Learn
www.phoenixlaser.com

France

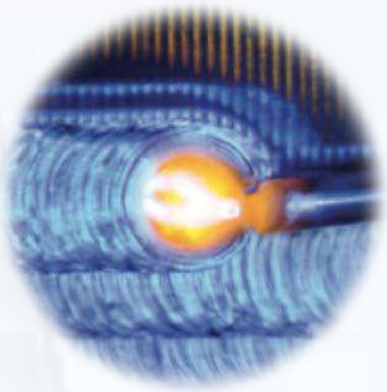
Alpha Laser GmbH
(Branch office France)
Mr. Franck Fleury
www.alphalaser.de

New Zealand

Triton Laser Solutions
Auckland
Mr. Stefan Beikircher
www.tritonlasersolutions.co.nz

ALPHALASER

SOUTHEAST ASIA



DSI

PULSE LASER WELDING



"DSI Total Solution

for

Pulse Laser Welding

in whole

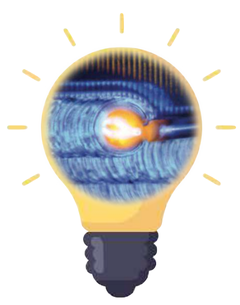
Southeast Asia"

Since 2000 located in Southeast Asia, *DSI Laser Service (Thailand) follows*

25 years of continuous development which leads to the concept of :

DSI Total Solution for ***Pulse Laser Welding*** with ***DSI Laser Wires***

- ✓ Pulse Laser Welding Service
- ✓ DSI Laser Welding Wires
- ✓ Machine processing / pre- and finishing of surfaces
- ✓ Authorised Dealer of ALPHA LASER Machines
- ✓ Service & Maintenance for ALPHA LASER Machines
- ✓ DSI Thailand Laser-Welding-Academy



Good to know :

DSI Laser Service (Thailand)

is

ALPHA LASER Southeast Asia



Thailand

ALPHA LASER Southeast Asia

DSI-Thailand Chonburi (Head office)

Pulse Laser Welding

ALPHA LASER SOUTHEAST ASIA



DSI Laser Service (Thailand) & ALPHA LASER Southeast Asia

Our Pulse Laser Welding Partners and Collaborations in Southeast Asia

Thailand

ALPHA LASER Southeast Asia Co., Ltd.
Chonburi (Head office)
Ms. Thongplew Banpao
www.dsilaser.com

Malaysia

DSI Symtrace SDN BHD
Sha Alam / KL
Mr. Edmund Ng
www.dsilaser-ms.com

Vietnam

LASERTECH Co.,Ltd.
Hanoi
Mr. Duong Ngoc Hai
www.lasertech.vn

Indonesia

PT DSI Laser Internasional Indonesia
Cikarang, Jawa Barat
Mr. Zhariansyah Ari
www.dsilaser.com

Indonesia

PT Bumi Cahaya Unggul
Jakarta Timur
Mr. Roy Heryadi Irawan
www.bcupt.id

DSI Laser Service (Thailand)

It's Showtime - Live on stage !

DSI Laser Service (Thailand) together with *ALPHA LASER Southeast Asia* and *DSI Thailand Laser-Welding-Academy* present the concept of ***DSI Total Solution*** for ***Pulse Laser Welding*** with ***DSI Laser Wires*** every year at different exhibitions in Thailand e.g. METALEX and InterMold On top we support our partners at exhibitions in Japan, Vietnam, Malaysia and New Zealand.



"It's all about Welding with pulsed Light and its Speed"





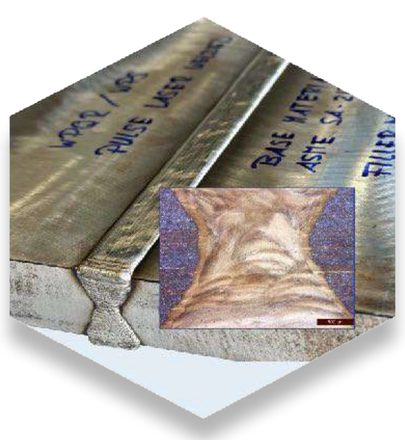
DSI live on Stage
Videos DSI-Dropbox

DSI

PULSE LASER WELDING







DSI Total Solution for *Pulse Laser Welding* with *DSI Laser Wires*

DVS ZERT

ISO 3834-2:2021

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