

## Course Description

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### Laser Welding Technology

***EQ and PQ - Equipment and Procedure Qualification***

This course emphasizes **material behavior** during laser welding

**Length: 36 instructional hours**

Basic concepts in material processing  
Classification of materials – material behavior  
Key characteristics of the laser beam

Industrial lasers and optics– selection of lasers for welding  
CO<sub>2</sub>, Nd:YAG, Direct Diode, Disk and Fiber lasers  
Beam delivery optics, including process fibers  
**Laser beam metrology** – selection of diagnostic devices

Pulsed laser welding  
Characteristics of pulsed welds  
**Computation of pulsed laser parameters – classroom work**  
**Computation of the pulse shapes – classroom work**  
Optimization techniques – **transient heat and cooling rate**  
Examples of Industrial Applications

Continuous power (CW) laser welding  
Characteristics of CW welds  
Setting up a new CW laser welding job  
**Computation of pulsed laser parameters – classroom work**  
Optimization techniques – temporal and spatial  
Examples of Industrial Applications **including LAM**

Metallurgy of laser welds  
**Surface preparation** techniques  
Alloying systems (several)  
Welding dissimilar metals

Filler metals - selection  
Re-welding laser welds

Weld geometry and shield gases  
Tolerances for lap welds, butt and fillet welds  
Tool design  
Guidelines to handling **transient and bulk heat**  
Selection of shielding gases – including use of air  
Effect of the shielding gas on weld quality

Weld defects their sources and corrective actions.  
Weld joint, heat sink, **surface tension**, etc.

Weld inspection methods  
Conventional destructive – metallography  
Non destructive – laser based ultrasonic, etc.  
**Real time weld monitoring** – *demo in class (time permitting)*

Documentation control  
Relevant EN, ISO and AWS Standards  
Review of the revised AWS C7.4 Laser Welding Standard.  
Comparison of the EN, ISO and AWS Laser weld standards  
How to define process parameters that are NOT covered by published Standards.

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#### General notes

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- There are no prerequisites for taking this course.
- 'Knowledge assessment' test will be given at the start and at the end of the Class to evaluate the progress made.
- Certificate of Attendance will be issued to all attendees at the completion of this Laser Welding course.
- Please bring with you a personal computer – to use with the **computation assignments in the class!**
- You may bring welded samples, technical data or documents to discuss with the instructor.
- You will receive the **electronic copies** of key computational formulas and the exclusive **HDE Pulsed Weld Algorithms**.
- You will also receive the **electronic copies** of the Equipment Qualification and Procedure Qualification Data Sheets.

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## Coverage of **LASER WELD DEFECTS** and analysis of weld defects

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1. The main objective of the HDE Laser Welding Technology course is to connect the behavior of materials during welding to the performance of the laser, beam delivery optics, tooling, weld geometry, etc.
2. Preventing weld defects (and then real time weld monitoring) is easier than correcting them afterwards! However, the subject is 'weld defects' (identification of the nature and the source of the defects, how to evaluate and how to correct them) is well covered! Look at the statics below.
3. Here are some statistics:

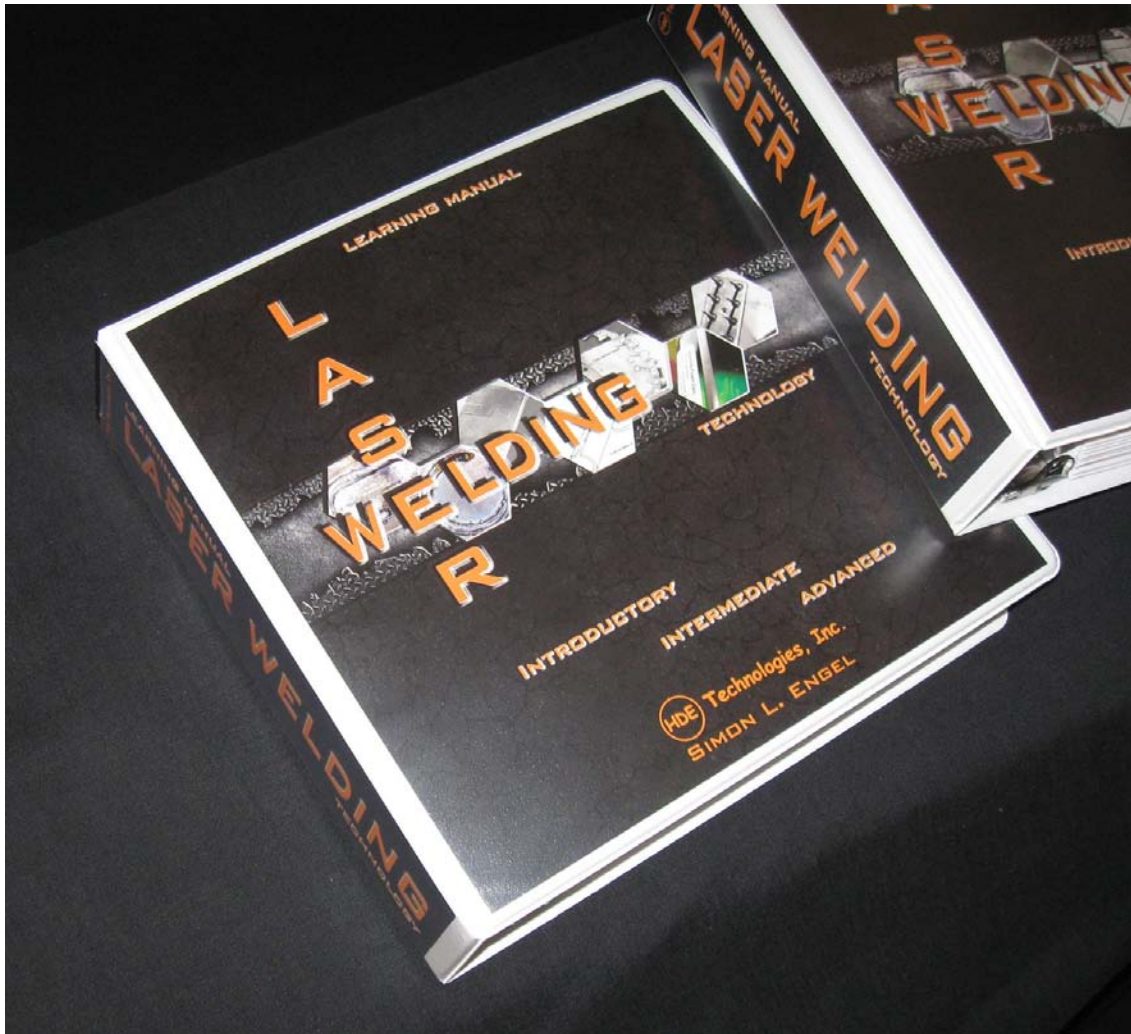
Total pages in the manual = 725 (approx.) + hand-outs

- 35+% of the course is directly related to weld defects.
- 66+ photos and illustrations related to weld defects.
- 20 complete sections of the manual related to weld defects.
- 8 computational algorithms that relate directly to weld defects.
- Weld inspection methods (traditional) = several complete sections.
- Weld inspection methods (real time weld monitoring) = 3 sections,
- 127+ illustrations, 2 PPT, 1 video, and (time permitting) class demo of a working LWM system!
- Classroom assignment: All use the supplied HDE mathematical algorithms to solve defective laser welds!

## **Take home the 'text book' on laser welding!**

- This is **the** Laser Welding course that attracted thousands of professionals over the last **41 years!**
- **The** Laser Welding course that attracted major corporations, even the staff from National Labs to learn about laser welding.
- Attend and learn how to optimize the productivity of your laser welding process!
- **Minimize TRANSIENT HEAT, control the cooling rate to minimize DISTORTION and damage to adjacent materials**
- Adapt this information to Laser Additive Manufacturing (**LAM**)
- Attend and learn how to achieve and maintain consistent quality laser welds!
- Attend and learn how to maintain your competitive edge in the International Market!

**Course Manager and Principal Instructor:** Simon L. Engel, President, HDE Technologies, Inc.  
Read more about Mr. Engel on the Main Page of [www.laserweldtraining.com](http://www.laserweldtraining.com) – look under '**Instructor(s)**'.



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## **Registration information – date, location and costs**

Please return to the Main Page of this Web Site and look at

**Schedules and Locations**

*and*

**Registration Forms**

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