



PREFACE

The Evolution of Precision

A Global Perspective on Scanner-Based Laser Processing

Why the Book was Necessary

Thousands of laser books — yet almost none written for the factory floor

The Publishing Landscape

2,273 scientific books on lasers since 1978

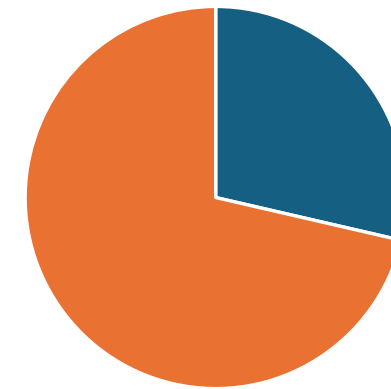
28.6 % of them relate to Engineering

51 on manufacturing & materials processing

24 on business, management & accounting

“If there’s a book you’d like to read but which hasn’t been written yet, then you’ll have to write it yourself.”

Toni Morrison (1931–2019)



Engineering 28.6 % Other 71.4 %

Breakdown of books published between 1978 and 2026 on the subject of lasers. Source: Scopus

Where This Book Began

A shared vision to make the complex accessible and the technical tangible



2023 — The First Book

“Von der Laserbeschriftung bis zum Lasermaterialabtrag” (From Laser Marking to Laser Material Ablation), co-authored with Prof. Dr. Christoph Hartl and Dr. Hans Wilhelm, published by Springer — a comprehensive overview for the German-speaking community.



What Readers Taught Us

Nearly one **hundred pages of physics** proved invaluable to physicists — but daunting to readers seeking a **more application-oriented** approach. The feedback pointed clearly toward the next step: a broader, more **globally accessible framework**.

Knowledge Should Transcend Borders

Rethinking how laser technology is taught, documented, and applied worldwide



A Global Language

English remains the lingua franca of science and engineering — the natural choice to reach a wider international audience.



A Global Perspective

A single national viewpoint could no longer represent a rapidly diversifying field. The book needed many voices, not one.



More Than a Year of Selection

Over a year of discussions and proposals went into assembling contributors who could represent — and enrich — their domains.

Development in Figures

From a modest plan in January 2024 to a 788-page international reference

The Plan

January 2024

3 potential authors

250 planned pages

18 months to completion

The Result

October 2026

16 renowned authors

788 pages, 411 illustrations

34 months to publication

800+ emails · 30 online meetings · countless calls and publisher negotiations



Meeting in Hull at Luxinar and Purex International, April 2025 — where books are made

Sixteen Authors, Five Countries

A distinguished international team embodying the collaborative spirit of the field



Germany



France



United Kingdom



Lithuania



Spain

Their combined expertise captures the state of the art while reflecting the distinct regional practices, innovations, and standards of today's laser industry.

Meet the Team of Authors

Sixteen specialists, one shared purpose

HS

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SV

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JL

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WB

Winfried Busch



What's Inside — Almost 800 Pages

Guiding the reader through the entire laser ecosystem



Laser Sources

CO₂, fiber, ultrashort-pulse and UV lasers.
Fundamentals and applications.



Scanner Technology

Beam steering, shaping and feedback control beyond
simple x–y motion



Software & Automation

Flexible software solutions with process monitoring and
automation



Safety & Sustainability

Laser safety, fume extraction, and responsible
manufacturing



Beam Shaping & Sensors

Cutting-edge process sensors for advanced process
control



Marketing & Implementation

Social media marketing, system design, selection and
implementation

Practical, Without Losing the Fundamentals

Bridging the gap between the laboratory and the factory floor



Solid Foundations

Introductory chapters on the fundamentals of laser physics ensure readers acquire a sound conceptual understanding before progressing to more complex systems and applications.



Unapologetically Practical

Written for both experienced professionals refining advanced processes and newcomers building a foundation — the balance between theory and practice lies at the heart of the mission.



CHAPTER 7

Laser Machines: Design, Selection & Purchase

A practical guide to industrial laser system architecture, machine selection criteria, and the procurement process

Three Parts, One Decision Journey

From understanding the technology to signing the purchase order



7.1

Machine Design

Laser sources, basic systems, safety classes, and the full spectrum of machine architectures — from tabletop to fully automated production cells.



7.2

Choosing the Right System

Matching laser wavelength to material, production volume, part size and weight, fume extraction, and control software.



7.3

Purchasing a Laser Machine

Quotations, sample parts, supplier visits, decision-making pitfalls, and what happens after delivery: installation and training.

What Do We Mean by "Laser"?

Three very different products hide behind one ambiguous word

1

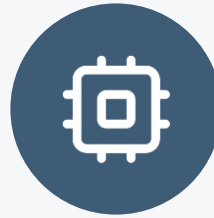


Laser Source

The bare engine: a CO₂ or fiber laser emitter.
Always Class 4. Built by specialists focused on one wavelength.



2



Laser Basic System

Source + scan head, F-Theta lens, control unit, computer and software — a ready-to-integrate module. Still Class 4.



3



Laser Machine

The basic system enclosed in a protective housing, ready to run in production — typically achieving safe Class 1.

Manufacturers like Luxinar build the laser source. KEYENCE sell only basic systems; specialists such as SK LASER cover laser machines.

From Tabletop to Heavy-Duty

Standard Class 1 machine formats for everyday production



Tabletop

Small footprint for labs and offices.
Batches of 1–200 items; limited by
access-door size.



Standing / Seated

Ergonomic workstation with a Z-axis
for focus. Flexible — the all-round
default machine.



Crane Loading

External drawer on rails, loaded by
crane or forklift for parts up to 2,500
kg.



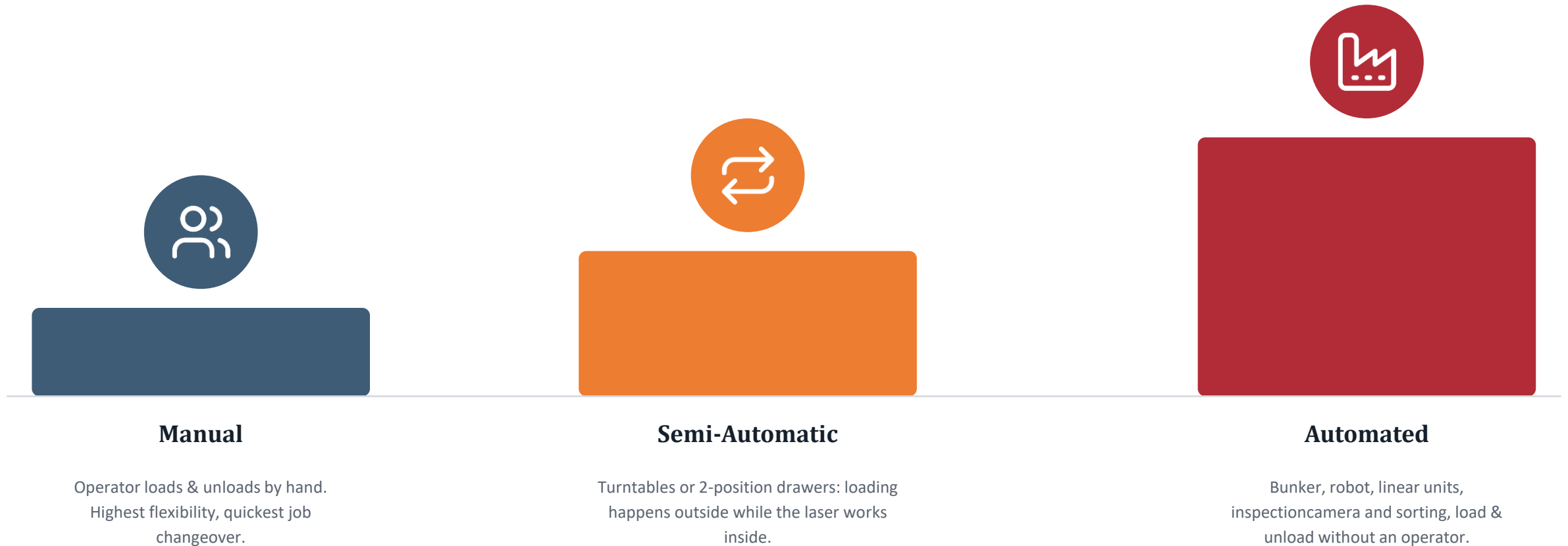
Mobile Laser

Wheeled cabinet, hand-held head.
Brought to oversized parts like ship
engines or steel coils.

Ergonomics matter: BGHM guidelines set worktable height at 63–75 cm (seated) or 85–95 cm (standing), with a motorised Z-axis for focus.

Climbing the Automation Ladder

More throughput means less flexibility — and a bigger investment



Choosing the Right Machine Design

Five questions the manufacturer needs answered before quoting

- 1 How many jobs need to be processed per day?
- 2 How many parts of the same type are processed in one job?
- 3 How heavy are the parts?
- 4 How big are the parts?
- 5 Is it a difficult 3D shape?

Typical Trade-offs

Open table (7.1.3.2)

Excellent flexibility, low cost, low know-how

Line-integrated (7.1.3.1)

No flexibility, but handles high volumes

Turntable (7.1.6.1)

Great for one big job; hard to set up new jobs

2-position drawer (7.1.6.2)

Flexible AND high volume; standard and semi automatec

Conveyor / robot cell (7.1.7)

Best for scale, highest cost & skill needs

Let Volume Decide the Automation Level

Jobs per month and units per job point to the right machine class

Number of Jobs per Month

1

Automated Machine

10

Semi-Automated Machine

100

Manual Machine

Fewer, larger jobs favor full automation; frequent small jobs favor a flexible manual station.

Number of Products per Job

1 – 100

Manual Machine

500 – 5,000

Semi-Automated Machine

500 – 1,000,000

Automated Machine

Semi-automatic systems bridge the gap: simultaneous loading and processing without full-line commitment.

Five Habits of a Good Buyer

Basic discipline that prevents an expensive mistake



Get Three Quotations

Compare pricing, technology level, and after-sales terms — one offer is never enough.



Request a Sample

Provide a precise template; ask every supplier to match the best sample you receive.



Visit the Supplier

See the team, the shop floor, and the origin of components in person — not just a website.



Trust Your Gut

Great technical data means little if the machine is awkward to use every day.



Ask the Right People

Operators, work planners and technical purchasing should define requirements — not interns alone.

Only ~10% of buyers evaluate total cost of ownership over ten years — service rates and spare-part pricing are often the real surprise.

Watch Out for These Buying Pitfalls

Who decides matters as much as what is decided



"Ass Protection"

Managers often prefer a large, established supplier — not because it's the best fit, but because the choice is personally “safe.” Nobody gets blamed for buying the well-known brand, even at a higher price.

Result: a technically excellent but less-known supplier can be overlooked purely for organizational-risk reasons.



The Intern-Only Analysis

Working students research the market and build tidy spreadsheets of specs and prices — but lack the experience to judge software reliability, service quality, or ease of use.

Fix: let operators, work planners, and technical purchasing draw up and evaluate the requirements themselves.

Before the Machine Arrives

A short checklist prevents costly surprises on delivery day



Is the location suitable, and is the floor vibration-free?



Enough electrical power — and compressed air or cooling water if required?



Is the environment free of dust and oily air?



Is a CE declaration of conformity included with the machine?



Does the machine fit through every door and, if needed, the elevator?



Are hardware and software instruction manuals provided in the local language?

Most laser machines tolerate 15–35°C and up to 80% humidity — but the installation site should be as clean and dust-free as the process demands.

Installation, Then Three Stages of Training



What the Technician Does

- Connects cables and wires; re-assembles transport-loosened parts
- Aligns the machine and checks level with a spirit level
- Calibrates the laser head if not already done
- Runs functional tests before handing over to training



Training in Three Steps

1. Hardware

Components, connections, network/USB options, dust maintenance

2. Software

Setting focus, running a test of power × speed to find parameters

3. Operation

Job setup, serialisation, calibration — tailored to daily workload

Tip: avoid automatic Windows updates on the control PC — an update can silently reset laser settings.

Key Takeaways



Design

Choose the automation level and safety enclosure that fit your part size, weight and 3D complexity.



Selection

Let material, volume, dimensions and software capability drive laser wavelength and machine type.



Purchase

Three quotations, a real sample, a site visit — and let the people who run the machine choose it.



With Gratitude

To my co-authors, for their dedication and expertise.

To our readers, for their curiosity and engagement.