# From Angle Grinders to Continuous Laser Cleaning: A Continuous-Improvement Business Case for Two Land Rigs

*Continuous Laser Cleaning — Business Case*

**Content authored by François Dorléans**

*AI transparency: this English revision was drafted with Claude (Anthropic) from François Dorléans's prior French working memos (Rev. 01–04); technical judgments, sourcing decisions, and the vendor-neutrality position remain the author's own.*

**Document ID:** MEMO-EE-HSE-LASER-DISC-2026-01

**Revision:** 05-C

**Date:** 11/09/2026

**Language:** English (translated and reframed from the French working memos)

**Author:** François Dorléans · EngEthics Consulting · fdorleans@engethics.org

**Status:** Continuous-improvement / business-case reframing — working document, not a site-measured cost study

**Keywords:** angle grinder, laser cleaning, continuous improvement, business case, ROI, utilization rate, HSE, HAVS, LGAC, contact lenses, drilling rig maintenance

**Method:** Evidence tagged (a) established / (b) plausible extrapolation / (c) working hypothesis; no invented figures; unverified claims flagged [UNCONFIRMED]

**Proposed publication:** EngEthics — drilling / tooling section (primary); short HSE excerpt possible for Stichting Yiha

## Revision History

Revision 01 — Initial French memo: angle grinders vs. Needle® Netalux laser cleaning, five-year comparative framework.

Revision 02 — Added precision on the contact-lens desiccation risk under laser/IR exposure.

Revision 04 — Full EngEthics/Grok documentary methodology applied: (a)/(b)/(c) evidence tagging, contact-lens mythology review, acronym glossary, complete reference list.

Revision 05-C — English translation; reframed under a continuous-improvement methodology with a dedicated business-case section; explicit vendor-neutrality disclaimer added regarding Netalux; rig designations anonymized ("two rigs", no unit numbers); utilization intensity established as the primary ROI driver. (Claude)

*No prior entry has been removed; this history is cumulative.*

## 0. Editorial Note — Continuous-Improvement Framing and Vendor Neutrality

This document is an internal continuous-improvement working paper. It is not sponsored, reviewed, or endorsed by any equipment manufacturer, and it does not constitute a commercial recommendation.

**Vendor-neutrality disclaimer.** Netalux and its Needle® laser-cleaning product line are referenced throughout this document solely as a publicly documented, leading-edge European example of industrial fiber-laser cleaning technology. The author holds **no economic, financial, contractual, or commercial interest** in Netalux, its distributors, or any competing laser-cleaning vendor, and is **not mandated, sponsored, or authorized by Netalux** to represent, endorse, or speak on the company's behalf. All specifications cited are drawn from Netalux's own public product page and are marked accordingly; no vendor-supplied commercial or confidential data were used. Any other laser-cleaning system with equivalent technical characteristics (pulsed fiber laser, Class 4, comparable duty cycle and extraction performance) would support the same continuous-improvement and business-case reasoning developed here — Netalux is an illustration, not a recommendation.

For the same reason, the two rigs discussed below are described generically. No fleet or unit designation is used; the analysis concerns the surface-preparation task itself (rust, coatings, weld areas, access zones), which is transferable to comparable land rigs.

## 1. Executive Summary

Surface cleaning and preparation on drilling rigs — descaling rust, removing coatings, preparing weld zones and access areas — is a recurring maintenance task, today carried out mostly with handheld angle grinders. Read through a continuous-improvement lens, this task is a standing source of waste: safety exposure (cuts, kickback, vibration, dust), rework from inconsistent surface quality, consumable spend, and downtime for incident management and PPE compliance.

Laser cleaning — illustrated here by the Netalux Needle® platform as a public, leading-edge European example — removes the rotating abrasive disc and its associated hazards, and can, if extraction is properly sized, substantially cut airborne dust exposure. It does not remove risk altogether: Class-4 laser hazards and laser-generated air contaminants (LGAC) replace mechanical hazards and must be actively managed.

The central finding of this revision is methodological rather than financial: ***the economics of laser cleaning are driven overwhelmingly by utilization intensity.*** A machine used occasionally, as a substitute tool kept in reserve for hard cases, will structurally fail to pay back its capital and training cost. The business case only closes when the tool is scheduled into near-continuous duty across the maintenance programs of both rigs — i.e., treated as standard equipment, not a specialty exception. Section 6 develops this argument and the scenario logic behind it.

No site-measured total cost of ownership (TCO) is presented — that data does not yet exist for this fleet. What follows is a rigorously sourced problem statement, an honest risk comparison, and a business-case framework designed to guide a chargeable pilot.

## 2. Problem Statement — Angle Grinding as a Source of Waste

In continuous-improvement terms, the current state (angle grinding) can be described as a stable process with well-documented, chronic waste streams rather than a single acute failure. None of the following facts is new or alarming in isolation; together they describe a maintenance task that has never been re-examined as a whole:

• Safety waste: angle grinders are consistently ranked among the most hazardous portable tools in independent national statistics (Section 4) — projections, kickback, hand-arm vibration syndrome (HAVS), and silica/metal dust.

• Quality waste: abrasive removal is not selective; it risks removing sound substrate along with the target layer, and can cross-contaminate adjacent surfaces.

• Compliance and administrative waste: rotating abrasive tools carry a standing competence and maintenance burden (PUWER-equivalent frameworks, periodic refresher training, guard inspection).

• Consumable and downtime waste: discs, confinement of dust, incident handling, and PPE turnover are recurring, if individually modest, cost lines.

The working hypothesis of this memo is that a substitution — partial or full — by laser cleaning, paired with disciplined training and a properly sized extraction system, is a credible countermeasure to this waste profile. Section 6 is explicit that this hypothesis becomes a real business case only under sustained utilization, not as a one-off equipment swap.

## 3. Technical Scope

### 3.1 Two rigs — surface-preparation tasks

The scope is two land drilling rigs of a recent generation (mast class in the region of 350 t, consistent with current operator fleets). This memo addresses only the *surface cleaning and preparation* work performed on and around these rigs — rust, coatings, weld areas, access zones — not the drilling operation itself. No unit or fleet designation is used in this revision (see Section 0).

### 3.2 Illustrative technology — Needle® (Netalux), public manufacturer data

Source: Netalux public product page, https://netalux.com/product/needle/ — cited here purely as a technical illustration, per the disclaimer in Section 0.

| Parameter | Needle 100/150 | Needle 200/300 | Status |
|---|---|---|---|
| Laser type | Pulsed Yb fiber, ns | Same | (a) manufacturer |
| Wavelength | 1064 nm | 1064 nm | (a) |
| Laser class | 4 | 4 | (a) |
| Average power | 100 / 150 W | 200 / 300 W | (a) |
| Approx. mass | ~20 kg | ~43 kg | (a) |
| Extraction — rated flow / HEPA | Not published | Not published | [UNCONFIRMED — to request] |

The manufacturer's claim of "captured contamination" is a marketing statement; rated extraction flow and filtration grade are not published on the product sheet and must be requested before any dust/fume claim is used in publication. In industrial practice, laser-generated air contaminants (LGAC) require extraction and filtration sized to the specific contaminant (lead or chromium-bearing paints, metal oxides, etc.).

## 4. Angle-Grinder Risk Evidence (Sourced)

### 4.1 What is well established

• UK (RoSPA HASS/LASS, early 2000s): angle grinders repeatedly cited as the third most hazardous handheld tool, on the order of 5,000–5,400 injuries/year in that national series — Carter et al., Head Face Med. 2008, DOI 10.1186/1746-160X-4-1; Soong et al., Trauma Case Rep. 2021, PMC7900576.

• UK HSE: HSG17 (Safety in the use of abrasive wheels) covers wheel burst, contact injuries, dust, noise, and vibration. There is no dedicated annual RIDDOR series isolating "angle grinders" alone.

• France (INRS): roughly 55,000 work-related machine injuries/year nationally; grinders/angle grinders are among the most harmful portable tools (noise + vibration + dust + cuts combined), without an isolated national figure for grinders alone.

• Australia (WorkSafe WA/NT): angle grinders are flagged among the most hazardous tools, with kickback highlighted in specific safety alerts (e.g., 9-inch discs).

• Documented mechanisms: disc burst/projection, cuts, kickback, noise, HAVS (UK HSE INDG175: exposure action value 2.5 m/s² A(8), exposure limit value 5 m/s²), and silica or metal/paint dust from grinding concrete, stone, or coated surfaces.

### 4.2 What should not be recycled as a "global survey"

| Common claim | Status |
|---|---|
| "5,400 injuries — global figure" | No — this is the UK RoSPA base rate, frequently recycled out of context |
| "~25,000 injuries/year, CPSC" | [UNCONFIRMED] — no primary CPSC estimate located |
| "20% kickback fatality rate, OSHA" | [UNCONFIRMED] — secondary claim, no primary OSHA report located |

Conclusion: there is a convergent body of national literature and regulatory guidance on angle-grinder hazard, but no single homogeneous global survey. For a site HSE case, national statistics plus local incident analysis plus HSG17-equivalent guidance should be preferred over headline global figures.

### 4.3 Maintenance and "recertification"

Under the UK framework, PUWER plus demonstrated competence (training and practical assessment) and HSG17 apply; HSG17 sets no fixed legal recertification interval — periodic refreshers (often 2–3 years in training-provider practice) are good practice, not a costed HSE obligation. A standardized €/tool/year maintenance cost is not robustly documented and would need to be built internally from discs, downtime, incidents, and PPE.

## 5. Laser Cleaning — Risks and the Contact-Lens Question

### 5.1 Established Class-4 / 1064 nm risks

Eye and skin hazard from direct beam and from specular and diffuse reflection, requiring a controlled zone, PPE with optical density suited to 1064 nm, and Laser Safety Officer (LSO) procedures under the applicable local framework (IEC 60825 / ANSI Z136). Cleaned metal surfaces increase reflection risk. Ablated fumes and particles (lead- or chromium-bearing paints, oxides) fall under COSHH-equivalent rules; extraction is not optional — a 2025 Virginia Transportation Research Council study found that without effective extraction, exposures can be unacceptable.

### 5.2 Contact lenses — not an advantage, a theoretical added risk

Position of this document: contact lenses are **in no case an advantage** when working near a laser. They provide no protection — they are not PPE. If anything, they may theoretically *worsen* ocular stress, chiefly through excessive drying of the tear film / ocular surface under thermal and IR effects associated with laser work, potentially compounded by closed PPE that reduces blinking.

| Claim | Verdict |
|---|---|
| Contact lenses protect against the laser | False — never a laser PPE (ANSI Z136; laser-safety literature) |
| Contact lenses are an HSE advantage | False — at best neutral under correct PPE; more plausibly an added risk factor to manage |
| Excessive drying / irritation under laser work (lenses) | Theoretical / plausible risk to take seriously in site policy (1064 nm IR, heat, dry air, plume) — a credible physiological mechanism, not dedicated laser-cleaning epidemiology |
| Lenses "fused" to the cornea | Myth, refuted for welding arcs (AWS, OSHA, FDA, NSC, CCOHS, AOA) — not to be confused with the drying risk |
| Laser injury proven more severe solely because of lens-wear, under correct PPE | [UNCONFIRMED] in the epidemiological literature — this does not cancel out prudence on drying/particle entrapment |

What is genuinely established (Lövsund, Nilsson et al., 1979, Scand J Work Environ Health) is a marked temperature rise and frequent complete desiccation of soft contact lenses under welding-arc and infrared-heater exposure in controlled rabbit-eye experiments, with adequate welding shields preventing the effect (DOI 10.5271/sjweh.3102; DOI 10.5271/sjweh.3100). Extending this mechanism to 1064 nm industrial laser cleaning is a plausible (b) extrapolation, not a dedicated (a) epidemiological finding. Recommended policy remains prudent: avoid contact lenses in controlled laser zones; if worn, identify wearers and instruct immediate removal on irritation; laser PPE (optical density matched to 1064 nm) is mandatory regardless.

## 6. The Business Case — Utilization Intensity as the Primary Value Driver

This is the section that turns a technically sound HSE improvement into a defensible investment decision. The argument is deliberately conservative: it does not invent a site TCO, because the underlying hours and costs are not yet measured (Section 8 proposes how to get them). What it does establish, from first principles and from the cost structure of the technology itself, is the single variable that will make or break the payback.

### 6.1 Five-year comparative framework

| Criterion | Angle grinders | Laser cleaning + training + extraction |
|---|---|---|
| Capex | Low | High — machine, filtration, laser PPE, training |
| Opex (5 yr) | Discs, bearings, PPE, dust confinement, incidents, downtime | Energy, optics/laser maintenance, filters, recalibration; little consumable spend |

| | | |
|---|---|---|
| Substrate quality | Abrasive removal; risk of over-removal, cross-contamination | More selective ablation if parameters are correct (b); occasional light mechanical touch-up where paint anchoring is insufficient |
| Dust / HSE | High — silica/metal/paint dust without LEV+RPE | No abrasive disc; LGAC must be extracted — HSE gain conditional on genuinely effective extraction |
| Moving parts | High-speed disc, kickback, guard | No disc; laser/reflection/zone risks instead |
| HAVS / tool noise | High — grinders are HSE-listed | No grinding-type vibration; extractor noise possible |
| Productivity | Often faster on thick coatings / large areas | Often slower on thick layers; advantage on complex zones / precision weld prep |
| Training | Abrasive-wheel competence / PUWER-equivalent | Manufacturer laser training plus site procedures |

### 6.2 Why continuity of use determines ROI

The capital and training cost of a laser-cleaning system is fixed and front-loaded; its running cost per hour of operation is comparatively low (energy, filters, recalibration) once purchased. This cost structure means the **effective cost per cleaned square metre falls as utilization rises** — the opposite of an angle grinder, whose cost is dominated by per-use consumables and scales roughly linearly with activity regardless of how continuously it is scheduled.

Three consequences follow directly from this structure, and they are the core of the business case:

1. Idle capital is the main risk to the payback, not the machine's unit cost. A Needle system kept in a container as a backup tool for "hard cases" carries its full capex and training cost while working a fraction of the hours needed to amortize it — this is the scenario most likely to produce a negative ROI and an unfair verdict on the technology itself.

2. Value comes from displacing angle-grinder hours across the full surface-prep workload of both rigs, not from a narrow set of showcase tasks (precision weld cleaning alone, for instance). The wider the share of grinding hours the laser tool actually absorbs, the faster the fixed cost is recovered.

3. Continuous use also compounds the HSE and quality benefits: a tool used daily generates the operating discipline, trained-operator depth, and process data (cycle times, parameter settings per coating type) that make it reliable and fast — benefits that a rarely used machine, and its rarely practiced operators, will not realize.

The practical implication for planning: the laser-cleaning investment should be evaluated, and if adopted, scheduled, as **standard equipment integrated into the routine maintenance program of both rigs**, not as a specialty tool reserved for exceptional cases. A pilot designed around occasional or showcase use will systematically understate both the safety benefit and the return on investment.

### 6.3 Scenario logic — low vs. high utilization

No invented monetary figures are used here — the two scenarios below are a qualitative decision framework, tagged (c) working hypothesis, meant to guide how the pilot in Section 8 should be designed and read, not to substitute for it.

| Utilization pattern | Expected payback trajectory | Expected HSE / quality outcome |
|---|---|---|
| Low — occasional / showcase use, backup role | Capex and training cost poorly amortized; opex savings marginal; payback likely does not close within 5 years | Operators retain low practice; grinder hours barely reduced; dust and injury exposure largely unchanged |
| High — near-continuous, scheduled into routine surface prep on both rigs | Fixed cost spread over a large volume of displaced grinder hours; running cost stays low; payback plausible within the 5-year horizon, subject to pilot confirmation | Sustained operator competence, faster cycle times from practice, materially reduced grinder exposure and dust generation (conditional on extraction sizing per Section 3.2) |

The pilot proposed in Section 8 should therefore be designed to test the high-utilization scenario deliberately — scheduling the tool into a meaningful share of real surface-prep hours on both rigs for the pilot period — rather than defaulting to occasional trial use, which would only validate the low-utilization scenario and understate the technology's case.

## 7. Alternative Methods Considered

| Method | Interest | Limits |
|---|---|---|

| | | |
|---|---|---|
| Induction paint removal | Effective on thick coatings, little grit | Leaves debris; often needs a follow-up sweep blast |
| Dry ice blasting | Little abrasive residue | Noise, cold exposure, asphyxiation risk in confined spaces, $CO_2$ cost |
| Ultra-high-pressure waterjet | No silica-bearing abrasive | Effluent handling, high-pressure jet hazard, electrical needs |
| Needle guns / scalers | Good for localized work | High HAVS exposure |
| Grit blasting | Fast, good coating anchorage | Dust and waste generation |
| Chemical stripping | Effective on some coatings | Toxicity (e.g., dichloromethane-based strippers) |

For a rig, the most likely realistic outcome is a mix — laser cleaning for precision zones, welds, and confined access, combined with a mechanical or waterjet method for large, thick surfaces — rather than a full 100% substitution.

## 8. Recommended Validation / Pilot Plan

1. Map actual angle-grinder tasks on both rigs (hours/year, surface types).

2. Request from Netalux, in writing: rated extraction flow, filtration grade, and trial results on representative site coupons (rust/paint as found on site) — with the understanding, per Section 0, that this is a technical due-diligence request, not an endorsement.

3. Run a 3–6 month pilot with one Needle unit, trained operators, and a controlled laser zone, deliberately scheduled toward the high-utilization pattern described in Section 6.3 — not as an occasional backup tool.

4. Measure: cycle time, quality (remaining thickness, surface profile), dust/fume exposure, near-misses, and full costs.

5. Extrapolate a genuine 5-year TCO from these measurements — not before.

6. Fix the contact-lens policy: laser PPE plus a clear rule (documented conditional authorization under PPE, or a documented local prohibition).

## 9. Key Messages for Publication

1. Angle grinders are among the best-documented hazardous handheld tools (UK RoSPA + HSE, INRS, WorkSafe) — without there being a single homogeneous global survey.

2. Laser cleaning (Class 4), illustrated here by a leading European system, can reduce mechanical risk (no disc) and abrasive dust if extraction is genuinely sized for the task — this is a conditional gain, not an automatic one.

3. Contact lenses provide no protection and are not an advantage: a theoretically increased risk of excessive ocular drying under laser/IR exposure; HSE policy should be to avoid lenses in controlled laser zones. A proven-worse laser injury solely attributable to lens-wear under correct PPE remains [UNCONFIRMED] in the epidemiological literature.

4. The five-year comparison is, first, an HSE-and-quality case; the laser capex is justified once a costed pilot on the real tasks of both rigs is complete — and, critically, only if the tool is scheduled into continuous, routine use rather than occasional service.

5. Publication: EngEthics, drilling/tooling section; a short HSE excerpt is possible for Yiha.

6. Netalux is referenced as a public, illustrative European example; the author has no economic interest in the company and is not speaking on its behalf (Section 0).

## 10. Definitions of Acronyms

| Acronym | Definition |
|---|---|
| ACOEM | American College of Occupational and Environmental Medicine |
| ANSI | American National Standards Institute |
| AOA | American Optometric Association |
| AWS | American Welding Society |
| CCOHS | Canadian Centre for Occupational Health and Safety |
| EAV / ELV | Exposure Action Value / Exposure Limit Value (vibration, HSE) |
| FDA | U.S. Food and Drug Administration |
| HAVS | Hand-Arm Vibration Syndrome |
| HEPA | High-Efficiency Particulate Air (filter) |
| HSE | Health and Safety Executive (UK) |
| HSG17 | Health and Safety Guidance 17 — Safety in the use of abrasive wheels |
| IEC | International Electrotechnical Commission |
| INRS | Institut national de recherche et de sécurité (France) |
| IR | Infrared |
| LEV | Local Exhaust Ventilation |
| LGAC | Laser-Generated Air Contaminants |
| LPE | Laser Protective Eyewear |
| LSO | Laser Safety Officer |
| MMA | Manual Metal Arc (shielded-electrode welding) |
| NIOSH | National Institute for Occupational Safety and Health (USA) |
| nm | Nanometre |
| NSC | National Safety Council (USA) |
| OD | Optical Density (laser eyewear rating) |
| OSHA | Occupational Safety and Health Administration (USA) |
| PPE | Personal Protective Equipment |
| PUWER | Provision and Use of Work Equipment Regulations (UK) |
| ROI | Return on Investment |
| RoSPA | Royal Society for the Prevention of Accidents (UK) |
| TCO | Total Cost of Ownership |
| Yb | Ytterbium (laser fiber dopant) |
| λ | Wavelength |

## 11. References

1. American Welding Society (2023). Safety and Health Fact Sheet No. 12 — Contact Lens Use in Welding. https://aws-p-001-delivery.sitecorecontenthub.cloud/api/public/content/Fact-Sheet-No.12

2. Lövsund, P., Nilsson, S. E., et al. (1979). Temperature changes in contact lenses in connection with radiation from welding arcs. Scandinavian Journal of Work, Environment & Health. PubMed: https://pubmed.ncbi.nlm.nih.gov/20120575/

3. Lövsund, P., Nilsson, S. E., et al. Temperature changes in contact lenses in connection with radiation from infrared heaters. Scand J Work Environ Health. DOI: https://doi.org/10.5271/sjweh.3102

4. Transmittance and absorption properties of contact lenses. Scand J Work Environ Health. DOI: https://doi.org/10.5271/sjweh.3100

5. American College of Occupational and Environmental Medicine (2021). Use of Contact Lenses in an Industrial Environment. DOI: https://doi.org/10.1097/jom.0000000000002132

6. Canadian Centre for Occupational Health and Safety. Contact Lenses at Work / OSH Answers. https://www.ccohs.ca/oshanswers/prevention/contact_len.html

7. Smalley, P. J. (2011). Laser safety: Risks, hazards, and control measures. Laser Therapy. DOI: https://doi.org/10.5978/islsm.20.95

8. NIOSH. Current Intelligence Bulletin 59 — Contact Lens Use in a Chemical Environment. https://stacks.cdc.gov/view/cdc/7056

9. Carter, L. M., et al. (2008). Facial injuries from angle grinders. Head & Face Medicine, 4:1. DOI: https://doi.org/10.1186/1746-160X-4-1

10. Health and Safety Executive. HSG17 — Safety in the use of abrasive wheels. https://www.hse.gov.uk/pubns/books/hsg17.htm

11. Health and Safety Executive. INDG175 — Hand-arm vibration. https://www.hse.gov.uk/pubns/indg175.pdf

12. Netalux. Needle® laser cleaning (public specifications). https://netalux.com/product/needle/

13. Soong, J., et al. (2021). Angle grinder injuries. Trauma Case Reports. PMC: https://pmc.ncbi.nlm.nih.gov/articles/PMC7900576/

14. Virginia Transportation Research Council (2025). Induction and Laser Ablation... (extractors / LGAC). https://vtrc.virginia.gov/media/vtrc/vtrc-pdf/vtrc-pdf/26-R10.pdf

## 12. Limitations of This Document

• No site-measured 5-year TCO for the two rigs (hours and costs not yet collected).

• No published trial combining Netalux equipment and contact-lens wear was located.

• Full paywalled access to all SJWEH pages and the complete ANSI Z136 standard was not available in this session (abstracts plus convergent secondary organizations were used).

• The utilization-intensity argument in Section 6 is a cost-structure and continuous-improvement reasoning framework (c), not a measured result; it is designed to shape how the pilot in Section 8 is run and read, not to replace it.

# Index