



WP1 Definition of User Requirements

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Work Package 1

- 3 applications w/ individual requirements:
 - Quality
 - Cost/Productivity
 - Compatibility to manufacturing environment
- HIPERDIAS objectives/benefits:
 - Product enabling (Si structuring)
 - Product enhancement and cost reduction (diamond processing, fine metal cutting)
- WP1 objectives:
 - Align product/process requirements w/ system and laser developers' approach
 - Create basis to track progress throughout project



- Partners involved
 - End-users: Bosch, C4L, E6
 - System Development: USTUTT, AMP, AMO, XLIM, LASEA, GLO





WP1 – Tasks

Task 1.1: end-user application specifications

- Define target applications of BOSCH, C4L, E6
- Collect requirements regarding productivity, surface quality and contour accuracy
- Define boundary conditions (manufacturing environment)
- Task 1.2: Process and system specifications
 - Specify laser source, optics and system requirements for each application
 - Synchronize requirements with developers' boundary conditions
- Task 1.3: Assessment and validation of technical progress
 - Define key performance indicators (KPI) for quantitative progress assessment
 - Define necessary characterization and measurement methods

Task 1.4: Interface requirements

• Define the requirements of the software-technical interfaces





WP1 – Deliverables

| Deliverable title | Due date | Status |
|---|--------------------|--------------|
| D1.1 End-user application specifications | M04 – May 2016 | \checkmark |
| D1.2 Process and system specifications | M12 – January 2017 | \checkmark |
| D1.3 Prototypes and progress validation | M12 – January 2017 | \checkmark |
| D1.4 Definition of software-technical interface | M12 – January 2017 | \checkmark |





WP1 – Milestones

| Milestone title | Due date | Status |
|--|----------------------|--------------|
| MS5 Specification for laser parameters established | M08 – September 2016 | \checkmark |
| MS10 Key performance indicators for productivity progress specified | M10 – November 2016 | \checkmark |
| MS11 Key performance indicators for quality standards specified | M12 – January 2017 | ✓ |
| MS12 Specification for system technology established | M12 – January 2017 | \checkmark |





3D silicon processing – Bosch KPI's



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Fine cutting of metals – C4L KPI's



Product geometry features



Laser-machined part



Conventionally machined part w/ post-processing

| КРІ | Unit | Best Achieved | HIPERDIAS Objective |
|---|--------|---|---|
| Parts thickness | mm | 0.1-0.3 | 0.1 - 0.3 |
| Part dimensions | mm | Gear diameter: 5-10 Watch arm length: ca.20 | Gear diameter: 5-10 Watch arm length: ca.20 |
| Material covered | | Brass | Brass, sapphire, silicon |
| General dimensions tolerances | μm | NA | From ± 5 to ± 20 |
| Specific dimensions tolerances | μm | +-4.6 | +-2 |
| Smallest holes | μm | NA | From 50 to 100 |
| Maximal side steepness (individual, basic value 1°) | 0 | 2 | 1 |
| Average cutting speed (relative to shape and thickness) | mm/min | 30 | ≥400 |
| Shape deviation | μm | +-4.6 | +- 2 |
| Surface roughness (non-functional) | μm | NA | 0.4 (N5) |
| - Surface roughness (functional) | μm | 0.84 | 0.1 (N3) |

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Diamond polishing: E6 KPI's

A—Polishing Wheel **B**—Pneumatic Head C—Cooling Pipes D—Copper Head

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Conventional polishing machine



| Polishing Wheel Pneumatic Head | КРІ | Target | 5W femtosecond |
|---------------------------------------|-------------------------------|-------------------------------------|------------------------------|
| Cooling Pipes Copper Head | Material Removal Rate | > 0.150 mm ³ /s per disc | 0.0043 mm ³ /s |
| (mn) | Total Handling Time | < 10 min per disc | NA |
| | Post Processing/Cleaning Time | no post processing | NA |
| | Production Running Cost | < 5\$ per disc | NA |
| | Surface Roughness | Sa < 0.010 μm Sz < 0.12 μm | Sa = 0.35 μm Sz = 3.35 μm |
| | Shape Deviation | < +/- 2 μm | NA |
| Measurement of thickness variation | Visual Defects | pass rate 100% | NA |
| 200 10 20 Kut Scoref Wah Elsystel) | Cobalt Depletion | 0 % | Not measured yet |
| | Graphitization | No micro-structure modification | Not measured yet |
| neasurement of domed surface | Colour | L* < 15 | NA |

Flatness measureme

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Interface requirements – LASEA & C4L

- Scope, objective:
 - Specify interfaces between different system units (laser, scanner, axes, opto-mechanical elements)
- Aspects considered:
 - Electrical, mechanical, optical and software interfaces
 - Interface: limit layer between 2 components
- Achievements
 - Identified all different system interfaces relevant for each partner
 - Specification of interface requirements both from end-user and system side







WP1 – Conclusion

- All tasks completed all deliverables turned in and milestones achieved
- KPI's of each application defined
- Requirements and Interfaces established
- Basis for tracking of progress throughout project