

Example Proposal

Testing and Implementation of Rapid Quality Control with Microwave Heating

***This proposal is an example only.**

Prepared for: Dr. Alphabet, XYZ Inc

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Background

XYZ Inc. has an interest in speeding up their existing production processes by using microwaves as a fast batch check method for quality control. A Snap Shot Feasibility Study performed by Ceralink, indicated that parts could be sintered in 30 minutes to show comparable properties as the production firing (28 hours). Further work is required to confirm reproducibility and define the standard operating procedures. XYZ will benefit from a fast method to fire batch inspections. A preliminary study by Ceralink and XYZ showed that comparable shrinkage, density and material properties, could be obtained in approximately 30 minutes with microwave firing. This work proposes to standardize the method and transfer it to XYZ.

Project Description

An 18-week, \$55,000 project is proposed for the development of a Quality Control Microwave Firing Method. It will be accomplished in the following four stages:

Stage 1: Develop and Optimize the Microwave Process (7weeks \$22,000)

This will include a process for batch inspection. The thermal package will be designed to accommodate a range of standard parts. Optimization will focus on time reduction and property matching with conventional process.

Stage 2: Reproducibility Study (4 weeks \$15,000)

This will include reproducibility of shrinkage from run to run, with position in the run, and with load size.

Stage 3: Develop Standard Operating Procedures (3 weeks \$8000)

This will include procedures for using the microwave for batch inspection. One procedure may be sufficient for all parts, but it is possible that several procedures will be required depending on total mass in the run.

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Stage 4: Installation and Training at XYZ (1 week + follow up \$10,000)

A Ceralink engineer will install equipment and train XYZ QC personnel. Dr. Shulman will be available for consultation during training and will provide support through consultation for 3 months following the completion of this stage.

Statement of Work

Stage 1: Develop and optimize the microwave process

Task 1A. Design and fabricate refractory package.

Task 1B. Design and carry out statistical experiment (e.g. power, time, temp, load size, part type).

Task 1C. Measure shrinkage and density.

Task 1D. Design and carry out second level statistical experiment to optimize.

Task 1E. Measure shrinkage and density; XYZ to measure material properties.

Task 1F. Map temperature as a function of power/time profile.

Task 1G. Determine guidelines for optimized process for batch inspection.

Task 1H. Write technical report.

Stage 2: Reproducibility Study

Task 2A. Design and carry out statistical experiment (e.g. position, load size, part type)

Task 2B. Choose 1 part type and parameters from Stage 1 (Task 1G) and perform 30 runs in same thermal package.

Task 2C. Measure shrinkage and density of samples; XYZ to measure material properties of select samples.

Task 2D. Add new procedures if needed.

Task 2E. Make recommendations to XYZ on microwave equipment and accessory purchase.

Task 2D. Write technical report.

Stage 3: Develop Standard Operating Procedures

Task 3A. Determine if temperature measurement will be included in procedures.

Task 3B. Write preliminary SOPs

Task 3C. Test SOPs on technician and revise as necessary.

Task 3D. Work with XYZ QC personnel to adapt SOPs to XYZ format.

Task 3E. Write final SOPs.

Stage 4: Installation and Training at XYZ

Task 4A. Install microwave system at XYZ

Task 4B. Give demonstrations and training

Task 4C. Give support during first batch inspection

Deliverables

Stage 1:

- Technical report with details on microwave firing a batch inspection part and at least 3 actual parts with a variety of forms.

Stage 2:

- Technical report with details on reproducibility of microwave firing.

Stage 3:

- Standard operating procedures for batch inspection.

Stage 4:

- A working quality control microwave system and procedure transferred to XYZ

Example Budget

All materials and travel costs are included in the budget. Microwave equipment is not included. Ceralink will make recommendations on the equipment and accessory purchase.

<u>Stage 1:</u> Develop and Optimize the Microwave Process	\$22,000
<u>Stage 2:</u> Reproducibility Study	\$15,000
<u>Stage 3:</u> Develop Standard Operating Procedures	\$8,000
<u>Stage 4:</u> Installation and Training at XYZ	\$10,000
TOTAL	\$55,000
Commercial microwave equipment and accessory cost	\$18,000

Assumptions

- XYZ will supply sufficient dry parts in good time to keep the schedule.
- XYZ parts will be similar enough to be optimized with one basic procedure and only minor variations.
- XYZ will purchase the microwave system recommended by Ceralink or an equivalent for Stage 4.

Terms and Conditions of Agreement

Ceralink has an expectation to successfully develop a reliable reproducible system for microwave sintering XYZ materials and installing this system at XYZ to function as part of the quality control procedures. The microwave system is not included. Ceralink agrees to use its best efforts with the contract work in accordance with prevailing best practices in its industry. No specific testing outcome is represented or guaranteed, and payment for Ceralink services hereunder is not dependant upon the final results outcome of the project. Terms of payment and other general conditions are set forth on the attached Schedule A. This quotation is valid for 30 days.

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