M/s. Togle Automation Private Limited

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Submitted to

TAMIL NADU RESEARCH PARK FOUNDATION UNIVERSITY RESEARCH PARK (URP)
RESEARCH GRANT - INDUSTRY PROBLEM STATEMENT SUBMISSION

Proposal title

Development of a Manufacturing Process Standardization Model for Thin-Gauge (0.8mm - 1.5mm) MS and SS Biomass Stove

Submitted by: Togle Automation Private Limited, Chennai & Ranipet
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1. ABOUT TOGLE AUTOMATION PRIVATE LIMITED, CHENNAI & RANIPET

Togle Automation Private Limited, incorporated on 14.10.2020, is a cleantech MSME engaged in the design and in-house manufacturing of forced-draft biomass gasifier stoves under the brand "Mach Wood Stove." The company operates manufacturing facilities in Arcot, Tamil Nadu, and focuses on rural and semi-urban clean cooking solutions.

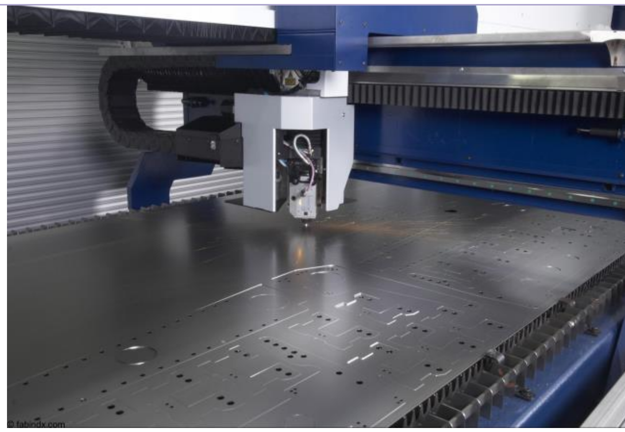
The Mach Wood Stove is a forced-draft biomass stove featuring an inverted conical frustum burner geometry, guided airflow system, and replaceable flanged burner design. The stove operates at controlled cooking temperatures (~350 – 450°C) and is designed using 1.6 mm mild steel and stainless steel sheet fabrication processes including cutting, rolling, forming, flanging, welding, and assembly.

While the product is commercially deployed and field-validated, manufacturing standardization and long-term structural reliability require structured scientific investigation.

The current manufacturing workflow includes:

Raw Material Procurement → CNC Laser Cutting → Sheet Roll Forming → Folding → Welding → Surface Finishing → Painting → Assembly → Packing & Storage

Process Sequence	Description	Purpose of the activity
1) Raw Material Procurement		Sourcing quality steel and components as per design standards.

2) CNC Laser Cutting		Precision cutting of sheet metal components using CNC laser systems to achieve accurate dimensions, hole patterns, and repeatability for minimal material wastage and high production consistency.
3) Sheet Roll Forming		Forming flat sheets into cylindrical or conical shapes required for combustion chambers and outer shells.
4) Folding		Bending sheet components to required angles and profiles for structural supports and functional assemblies. This enhances rigidity and ensures proper fitment during assembly.
5) Welding		Joining fabricated components using controlled welding techniques to achieve strong, leak-proof, and heat-resistant joints.

6) Surface Finishing		Removal of burrs, slag, welding spatter, and sharp edges through grinding and finishing operations. This improves safety, aesthetics, and paint adhesion quality.
7) Painting		Application of high-temperature resistant coating to protect against corrosion, oxidation, and thermal degradation. This enhances product lifespan and improves market-ready appearance.
8) Assembly		Integration of sub-components such as blower unit, ceramic insulation, air control mechanisms, and structural parts into the final product. Functional testing is performed to validate airflow and combustion efficiency.
9) Packaging		Secure packaging using protective materials to prevent transit damage and moisture exposure. Finished goods are stored systematically for inventory control and dispatch readiness.

2. PROBLEM STATEMENT

Development of a **Manufacturing Process Standardization Model** for thin-gauge 0.8 mm Stainless Steel, 1.6 mm mild steel biomass stove fabrication to establish:

1. Dimensional tolerance control during cutting and forming
2. Optimal bend radius and forming strain limits
3. Welding sequence optimization to minimize distortion
4. Jig and fixture design for repeatable assembly
5. Panel alignment and gap control methodology
6. Residual stress minimization protocol

The fabrication of 0.8 mm Stainless Steel and 1.6 mm mild steel biomass stoves presents challenges including burr formation during cutting, dimensional variability from manual operations, cracking at bend regions, weld-induced distortion, misalignment of panels, and inconsistent assembly quality. Thin sheets are highly sensitive to forming strain, heat input variation, and clamping inconsistency.

Currently, no validated **Design-for-Manufacturability (DFM) Protocol** exists that defines fabrication tolerance limits and process control parameters for consistent large-batch production.

This creates a structured manufacturing engineering research requirement requiring academic intervention.

3. RESEARCH GAP & INNOVATION COMPONENT

The project does not involve routine training or equipment procurement.

It aims to develop a **Design-for-Manufacturability (DFM) Protocol and Manufacturing Optimization Model** for thin-gauge biomass stove systems, including:

1. Comparative cutting accuracy evaluation
2. Dimensional tolerance mapping across production stages
3. Bend radius optimization for 1.6 mm MS and 0.8 mm SS
4. Forming strain and crack initiation study
5. Welding heat input vs distortion correlation
6. Fixture engineering for repeatable assembly
7. Residual stress measurement and mitigation
8. Statistical process capability validation

- The outcome will result in a validated **Production Engineering Standardization Model** applicable to sheet metal-based cleantech MSMEs.

4. TRL POSITIONING (URP COMPLIANCE)

Current TRL: 6

Current Status:

Commercially produced stove with functional market validation but without structured manufacturing tolerance validation or process engineering optimization.

Target TRL: 7

Target Outcome Under URP Project:

Standardized manufacturing protocol with validated tolerance limits, distortion control methods, and repeatable assembly framework demonstrated in operational production environment.

The project fits within URP support range (TRL 3–7) and focuses on manufacturing engineering advancement rather than market expansion.

5. SCOPE OF WORK EXPECTED FROM ACADEMIC PARTNER

The selected academic institution will undertake:

A. Cutting & Dimensional Accuracy Study

- Comparative evaluation of cutting techniques
- Burr formation analysis
- Dimensional deviation measurement study

B. Sheet Metal Forming Study

- Minimum safe bend radius determination
- Forming strain distribution analysis
- Crack initiation threshold study

C. Welding Process Optimization

- Heat input vs distortion mapping
- Welding sequence planning
- Residual stress assessment
- Weld joint quality benchmarking

D. Fixture & Assembly Engineering

- Jig and fixture design for repeatability
- Clamping force optimization
- Panel alignment standardization
- Gap tolerance control study

F. Process Capability & Standardization

- SOP development
- Manufacturing workflow optimization

6. EXPECTED DELIVERABLES

- Dimensional tolerance matrix
- Optimal bend radius specification
- Welding distortion control guideline
- Jig & fixture design documentation
- Residual stress reduction protocol
- Manufacturing SOP manual
- Process capability validation report
- Technical publication-ready documentation

7. INDUSTRY CONTRIBUTION

➢ **Financial Contribution**

Togle Automation Pvt. Ltd. commits to mandatory 50% match funding as per URP norms.

➢ **Non-Financial Contribution**

- Supply of fabricated samples
- Access to production facility
- Production data and workflow access
- Technical manpower coordination
- Implementation support for validated protocols

8. INTELLECTUAL PROPERTY FRAMEWORK

- ✓ Existing stove design IP remains with Togle Automation Pvt. Ltd.
- ✓ New DFM protocols, fixture innovations, or optimization methods developed shall be jointly owned proportional to contribution
- ✓ Industry retains first right of commercialization
- ✓ NDA mandatory prior to project initiation

9. MSME & ECOSYSTEM IMPACT

This project will:

• Improve manufacturing precision of thin-gauge cleantech products

• Reduce rejection rates and fabrication variability

• Strengthen MSME production engineering capability

• Create a replicable model for sheet metal MSMEs in Tamil Nadu

• Strengthen academia-industry manufacturing collaboration under URP

10. PROPOSED PROJECT DURATION

STAGE 01

Baseline Manufacturing Audit & Dimensional Mapping

STAGE 02

Sheet Metal Forming & Bend Study

STAGE 03

Welding Distortion & Residual Stress Study

STAGE 04

Fixture & Assembly Optimization

STAGE 05

11-12 Month

Process Capability Validation & SOP Finalization