RTB Working Paper

Roller Press Construction Guide

Dr Marcelo Precoppe

OCTOBER 2021

RESEARCH PROGRAM ON Roots, Tubers and Bananas

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Correct citation: Precoppe, M. Roller Press Construction Guide. CGIAR Research Program on Roots, Tubers and Bananas (RTB). RTB Working Paper. Available online at www.rtb.cgiar.org

Published by the CGIAR Research Program on Roots, Tubers and Bananas
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INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a perennial root crop native to South America and the main source of calories for many people living in sub-Saharan Africa. However, two days after harvest, the cassava roots become unsuitable for human consumption. To extend its shelf-life, the roots need to be processed into flour; a dried product that is used as the basis for many dishes. To process cassava into flour, the roots are peeled, grated, pressed, pulverized, dried, and milled. From those steps, drying is the most energy-intensive one. Therefore, dewatering before drying is an important step that results in significant energy savings. Dewatering is the step where water is removed by mechanical means instead of by evaporation.

Cassava dewatering can be considered as an expression operation, a separation process where the water is expelled from the wet cassava mash by pressure. In sub-Saharan African countries cassava dewatering is done using presses. Those presses usually have a perforated cage and a top piston. The mash, obtained by grating the roots, are placed in bags, and those bags are piled inside the cage one on top of the other. When the press is full, the piston is slowly lowered, squeezing the material, and forcing the water out, through the bags and the perforations in the cage. After pressing, the piston is raised and the bags containing the press cake are removed to be pulverized.

This kind of presses are popular because of their simplicity and low cost, but it has three major drawbacks: work drudgery, inconsistent reduction in moisture, and low throughput. Those drawbacks are associated with the fact that those presses operate in batches, instead of continuously. Continuous presses are used widely for the expression of fruit juices and oils from various oilseeds. They require less labour than batch operated presses, have higher throughput and their operation is more consistent. However, continuously operated dewatering equipment suitable to cassava processing centres in sub-Saharan Africa is not available. Therefore, the objective of this working paper is to provide instructions on how to build a simple and low-cost continuously operated cassava dewatering equipment.

EQUIPMENT OVERVIEW

This novel continuously operated dewatering machine was developed based on the design of roller presses, a piece of equipment commonly used for the expression of fibre-rich material. In a roller press, the material is fed between heavy fluted metal rollers, that squeezes it, and the water is forced out, flowing along the grooves (Figure 1). Roller presses consist normally of three rollers, but the one developed for cassava uses 12 of them (Figure 2).

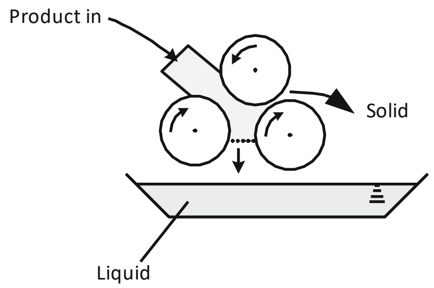


Figure 1. Schematic of a typical roller press with 3 rollers.

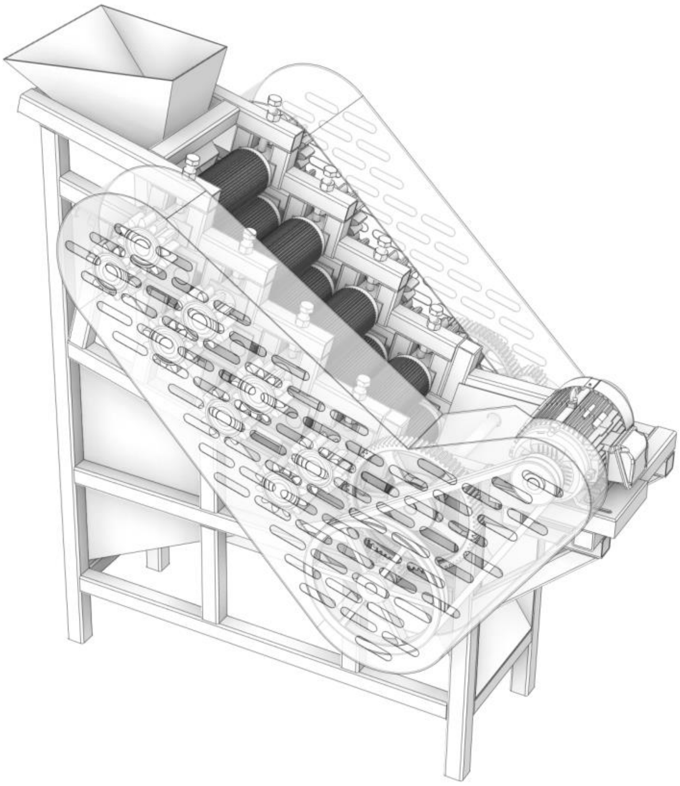


Figure 2. Overview of the roller press developed to dewater cassava in a continuous operation.

ROLLER PRESS COMPONENTS

FRAME

The frame is built with a 50 mm × 50 mm × 4 mm mild steel box section, coated with corrosion-resistant paint (Figure 3). The frame has the function to provide support to the other components of the press.

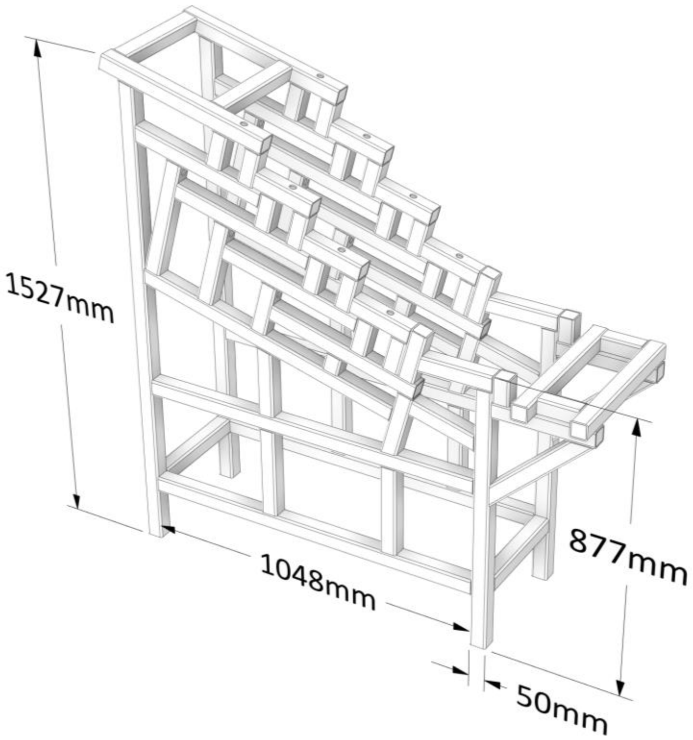


Figure 3. The frame, built with a mild steel box section, provides support for all components of the roller press.

HOPPER

The hopper has the function to store the wet cassava mash, temporary before it is discharged to the rollers. It is built using 3 mm thick stainless-steel sheets (Figure 4).

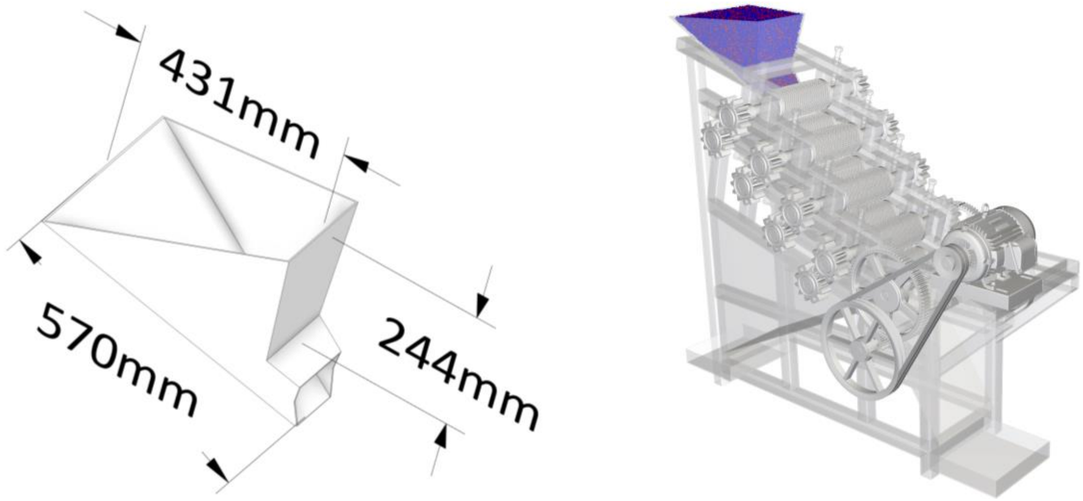


Figure 4. Hopper stores the material temporary before being discharged.

ROLLERS

The rollers must be built using food-grade materials like stainless steel or cast iron. Their function is to squeeze the material as it is forced to pass between them (Figure 5).

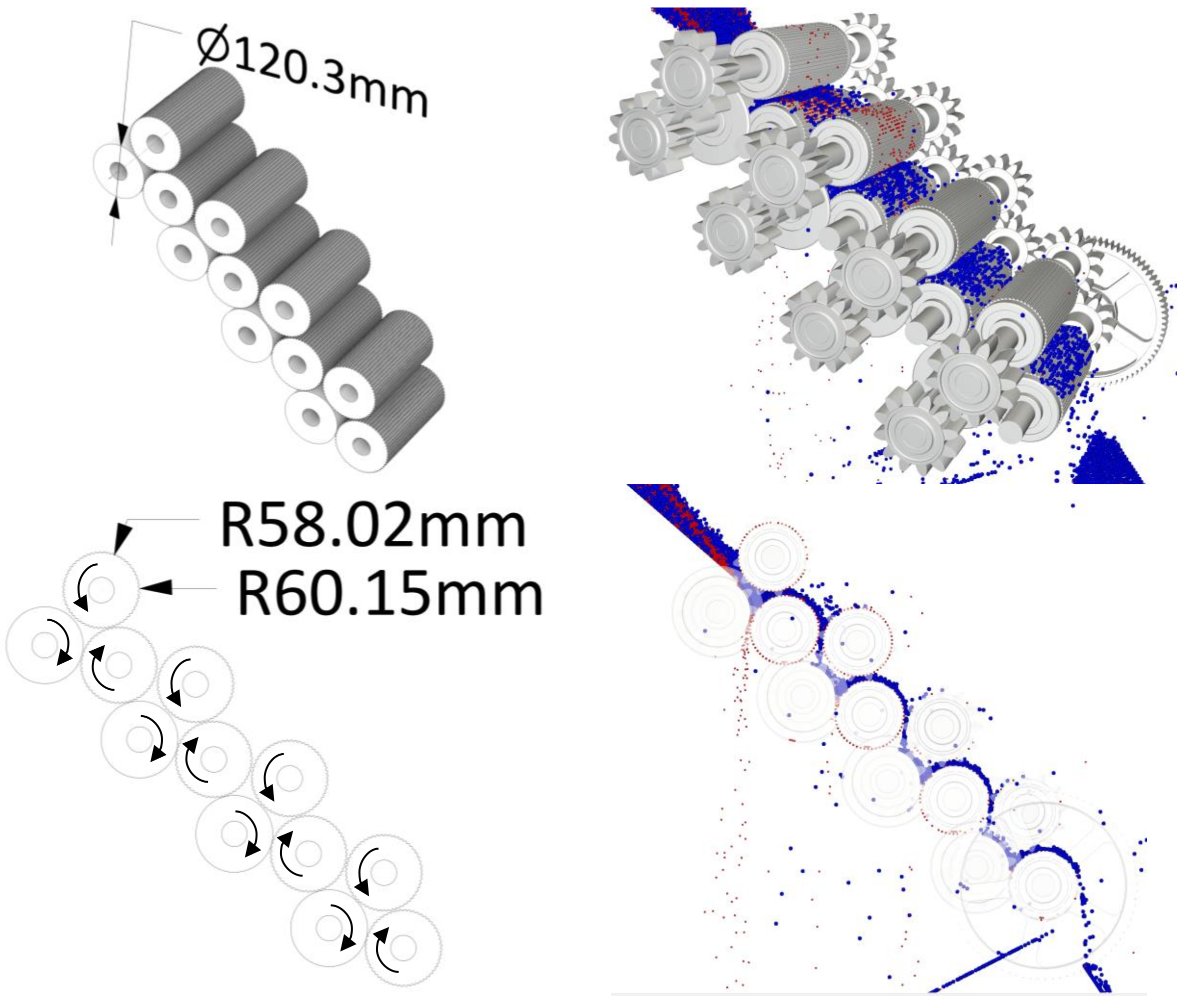


Figure 5. Rollers squeeze the material as it passes through it.

Some roller has a smooth surface, and some have a corrugate surface (Figure 6).

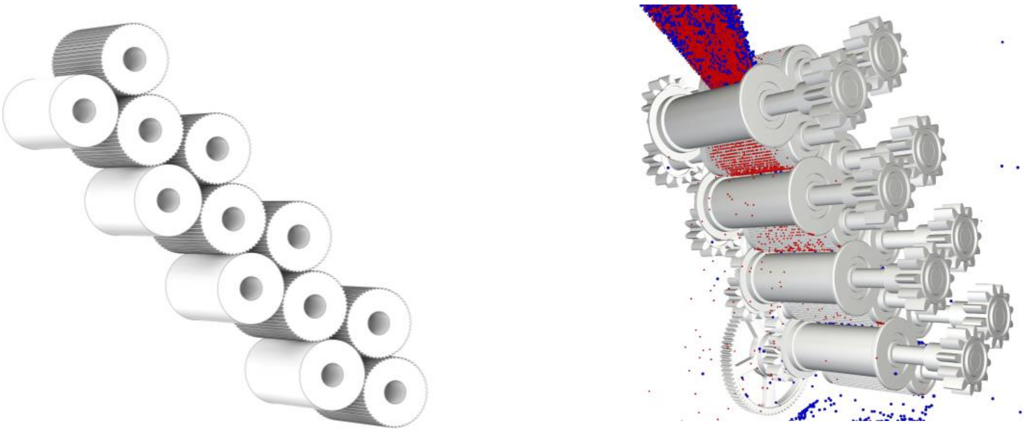


Figure 6. Rollers with corrugated and smooth surfaces.

ROLLERS SHAFT

The rollers are supported by a shaft with a diameter of 40 mm (Figure 7). The rollers are connected to the shaft with a keyed joint, consisted of a keyway and a key. In addition, to hold the joint in place retaining rigs are placed at each end of the roller. For simplicity keyed joints and retaining rings are not shown in the illustrations nor represented in the 3D CAD models.

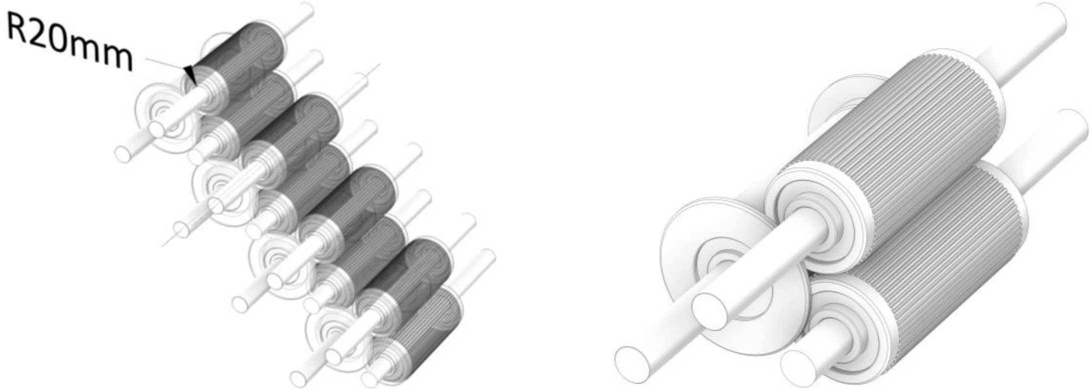


Figure 7. Rollers are supported by shafts, fixed by a keyed joint (not shown).

ROLLERS SPUR GEARS

Spur gears at the end of the shafts move the roller. Depending on the direction of the rotation, the spur gear is on the right end of the shaft, on the left shaft, or both ends (Figure 8). The shafts are connected to spur gear with a keyed joint, held by retaining rigs (not shown).

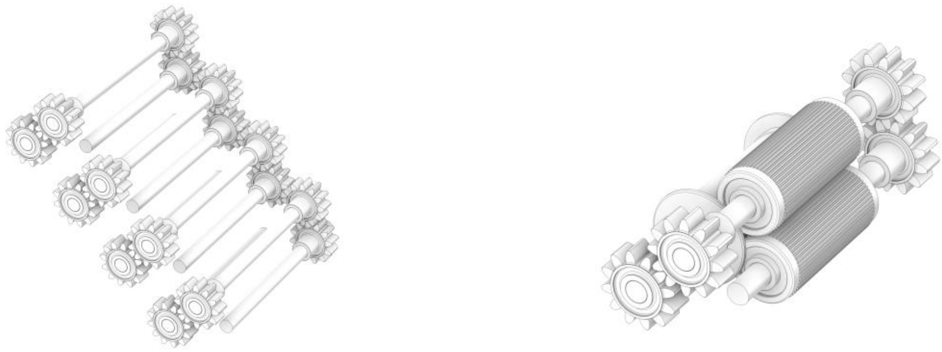


Figure 8. Spur gears at the end of the rollers shaft.

BUSHINGS

Bushings are used for the interfaces between the shaft and the frame, allowing the shaft to rotate and at the same time allowing to adjust the distance between the rollers by sliding the bushes along the frame (Figure 9). Retaining rings (not shown) are used to prevent the shaft from sliding out of the bushings.

Figure 9. Bushings allow the shafts to rotate and the distance between the rollers to be adjusted.

BOLTS

Bolts fixed to the frame with nuts are used to adjust the position of the bushings and thus control the distance between the rollers (Figure 10).

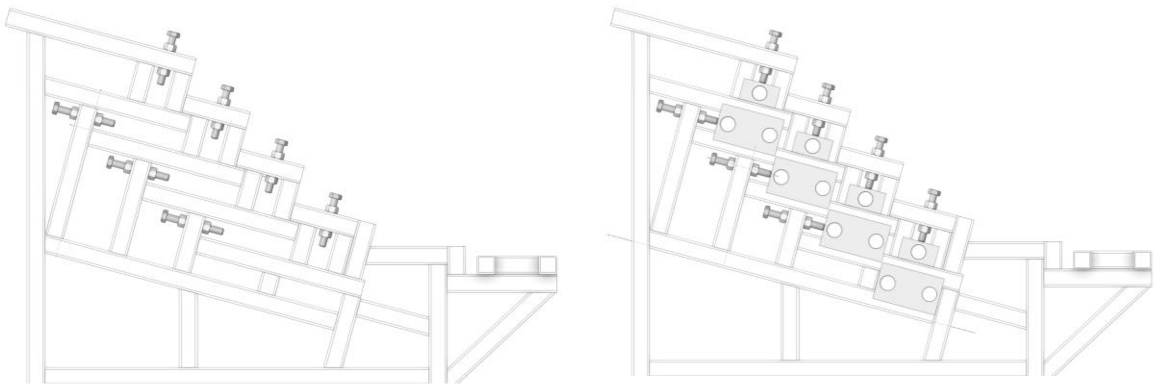


Figure 10. Bolts are used to move the bushes, controlling the distance between the rollers.

SOLID AND LIQUID COLLECTOR

Below the rollers, a collecting plate, made using stainless-steel sheet 3 mm thick, collects the water and the pressed cake. The water is directed to the back of the equipment and the press-cake to the front (Figure 11)

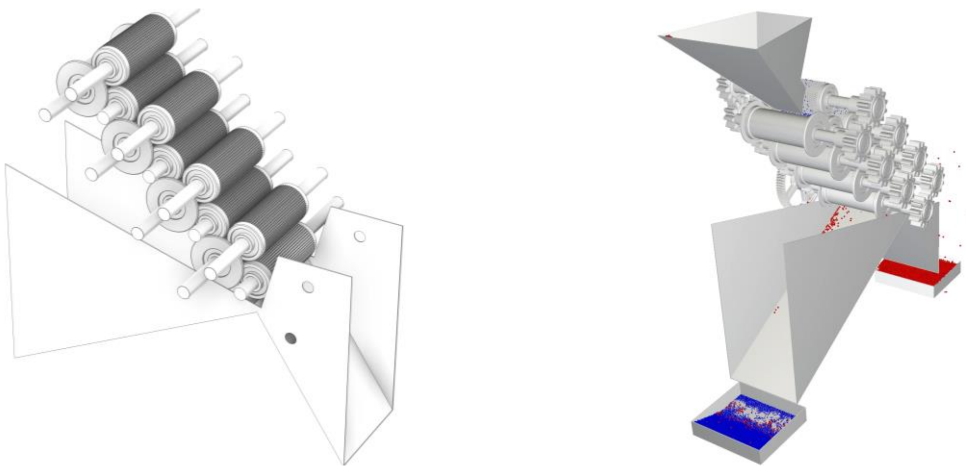


Figure 11. The collector underneath the rollers directs the liquid to the back and the solid to the front.

MOTOR

The system is powered by a standard 2.2 kW (3 hp) motor with a low-speed clockwise rotation. The motor is placed on a base plate that allows adjustment of the belt tension. The base plate is supported by the frame (Figure 12).

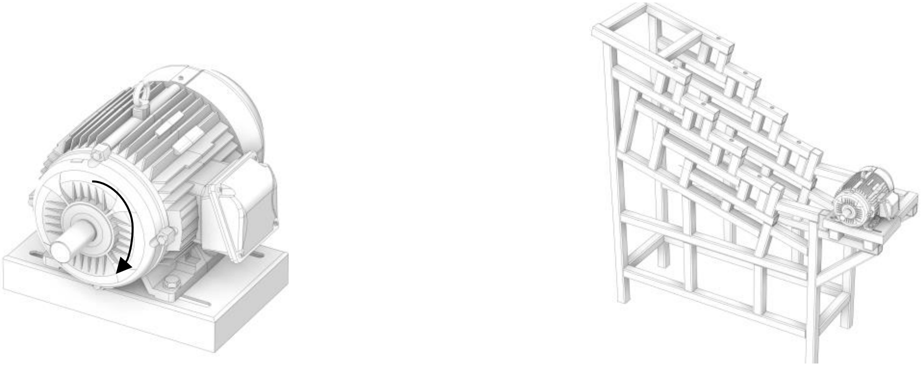


Figure 12. A standard 2.2 kW (3 hp) electric motor powers the roller press.

FIRST DRIVEN SHAFT

Power from the motor is transferred to a first driven shaft using a belt and pulley system. This first driven shaft is held by ball bearings fixed to the frame. At the other end of the first driven shaft, a flywheel is used to store the rotational energy (Figure 13).

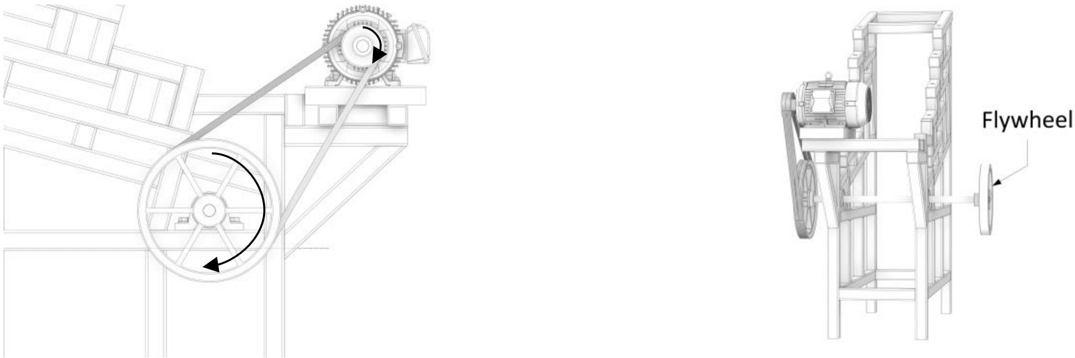


Figure 13. The belt and pulley are used to transfer power from the motor to the first driven shaft.

SECOND DRIVEN SHAFT

Power from the first driven shaft is transferred to the second driven shaft with spur gears. The second driven shaft is also held by ball bearings fixed to the frame (Figure 14). At the other end of the second driven shaft spur gears transfer the power to the lower roller, driving all the other rollers (Figure 15).

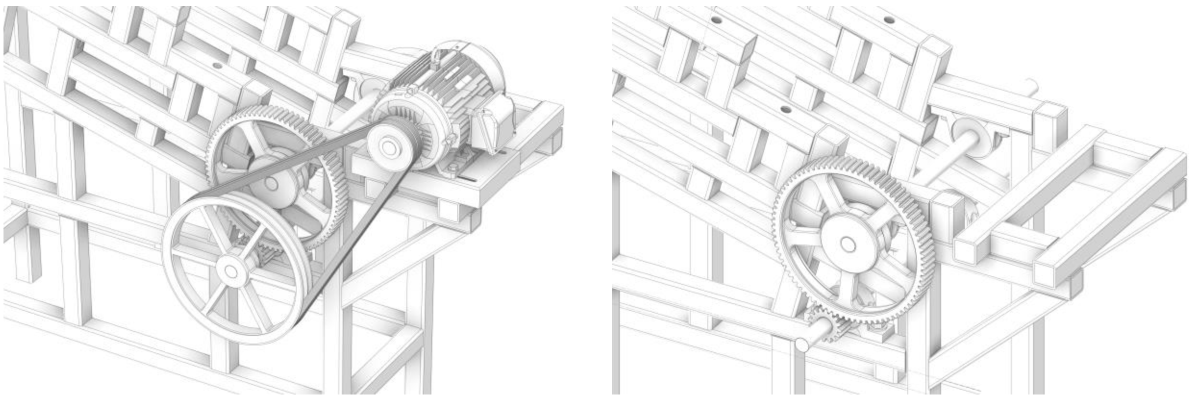


Figure 14. Spur gears transfer the power from the first driven shaft to the second driven shaft.

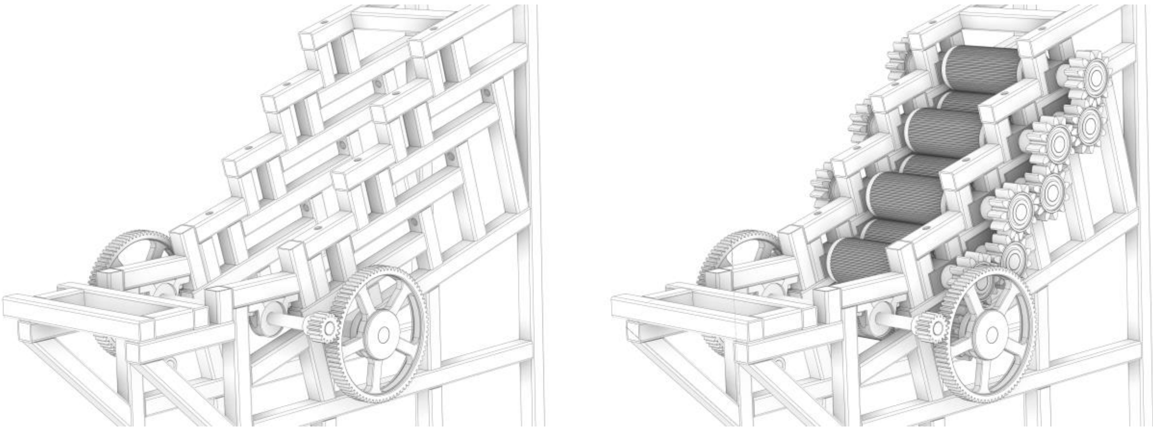


Figure 15. Spur gears transfer the power from the second driven shaft to the lower roller.

SAFETY GUARD

A safety guard, on each side of the roller press, encloses all the spur gears, pulleys, and belts (Figure 16). The safety guard is built with 3 mm thick mild steel sheets, coated with corrosive resistant paint.

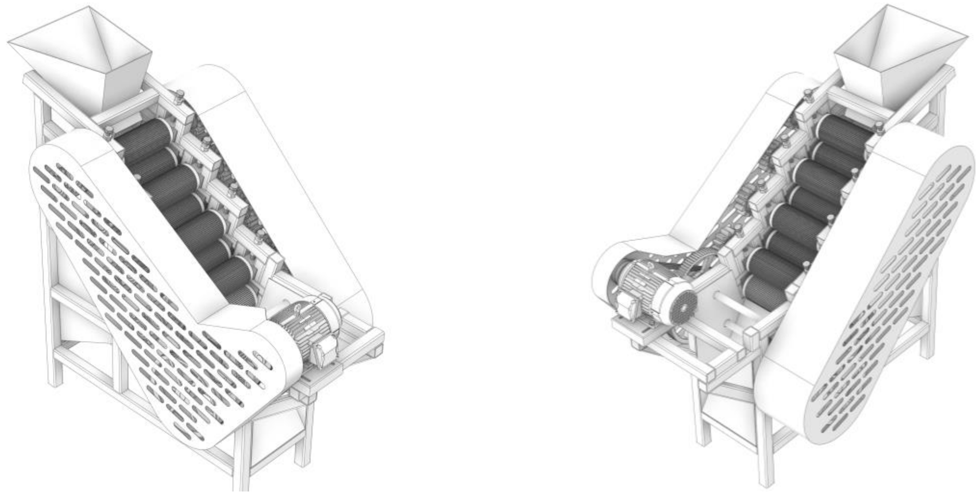
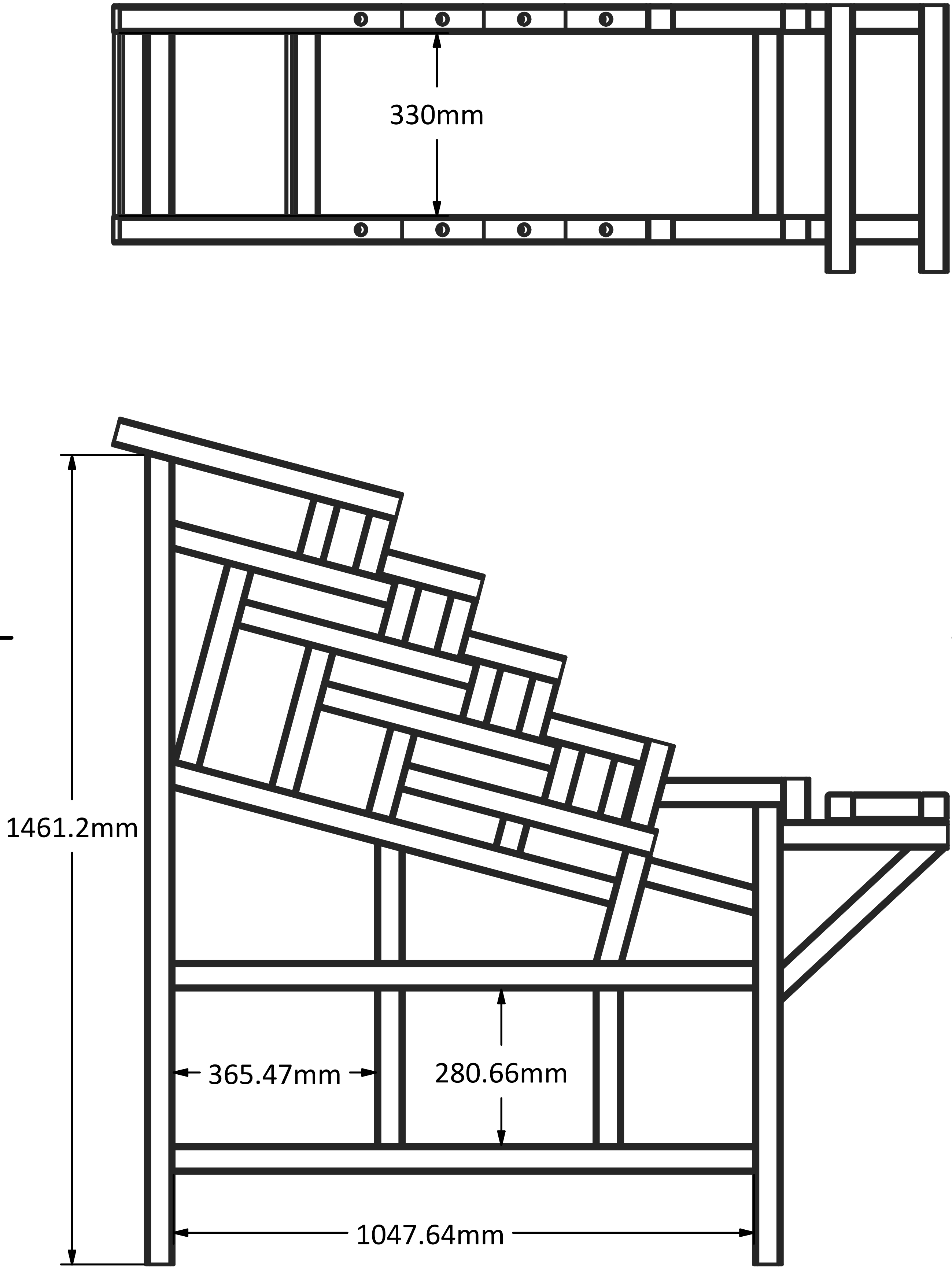


Figure 16. Safety guard on each side of the roller press.

EQUIPMENT OPERATION

The cassava mash, obtained from grating the roots, should be introduced to the hopper. The rotation of the rollers makes the material move along it, and as the mash is squeezed by the rollers, the water moves out of it. The amount of pressure is controlled by the distance between the rollers that are adjusted by tightening or loosening the bolts. The correct adjustment needs to be determined by try and error, testing different distances between the rollers. When adjusting the bolts, the motor must be switched off. This machine poses a risk of serious injury or death, maximum care must be taken during its operation.



SCALE 1:10	SIZE A4	DRAWING SHEET 1

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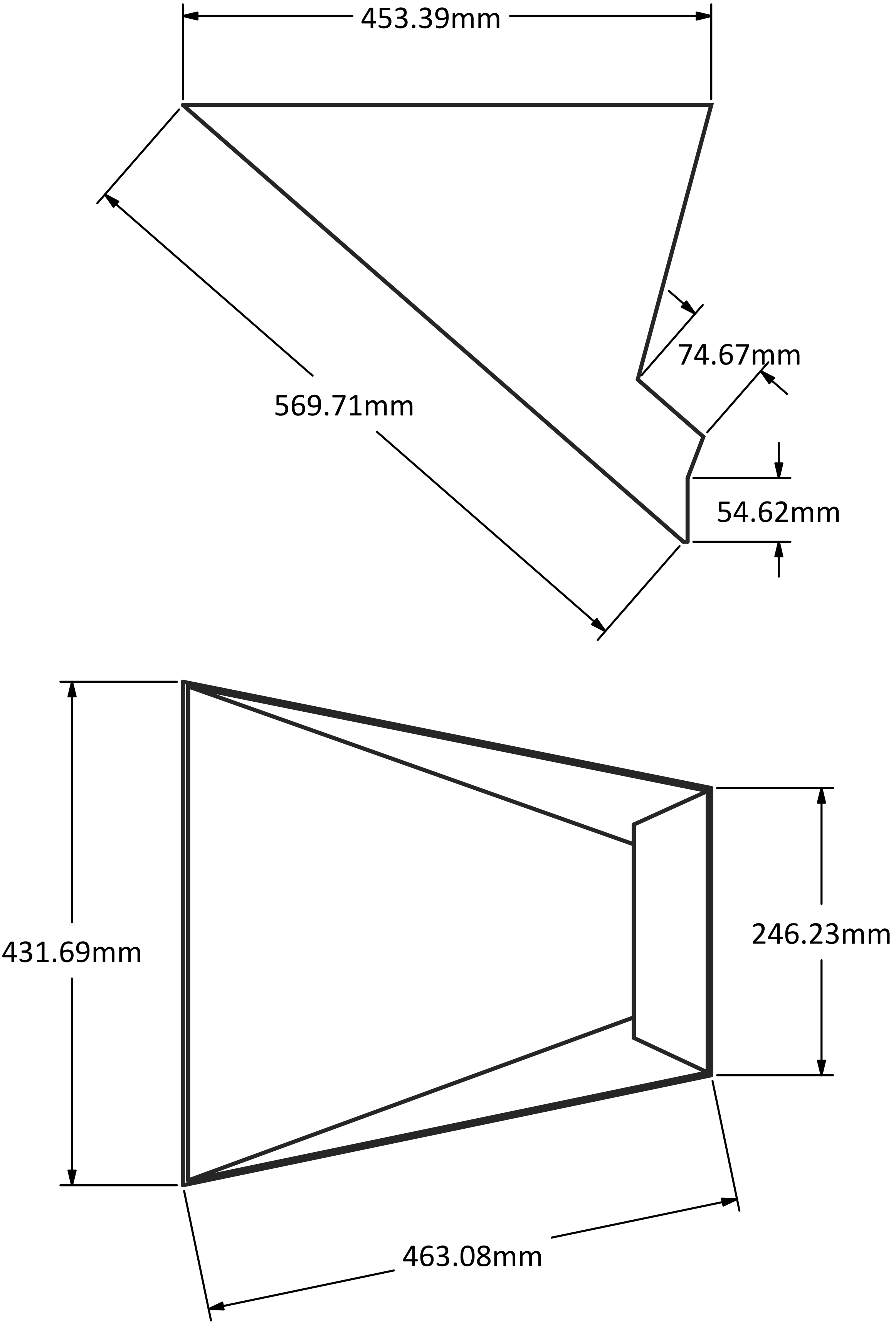
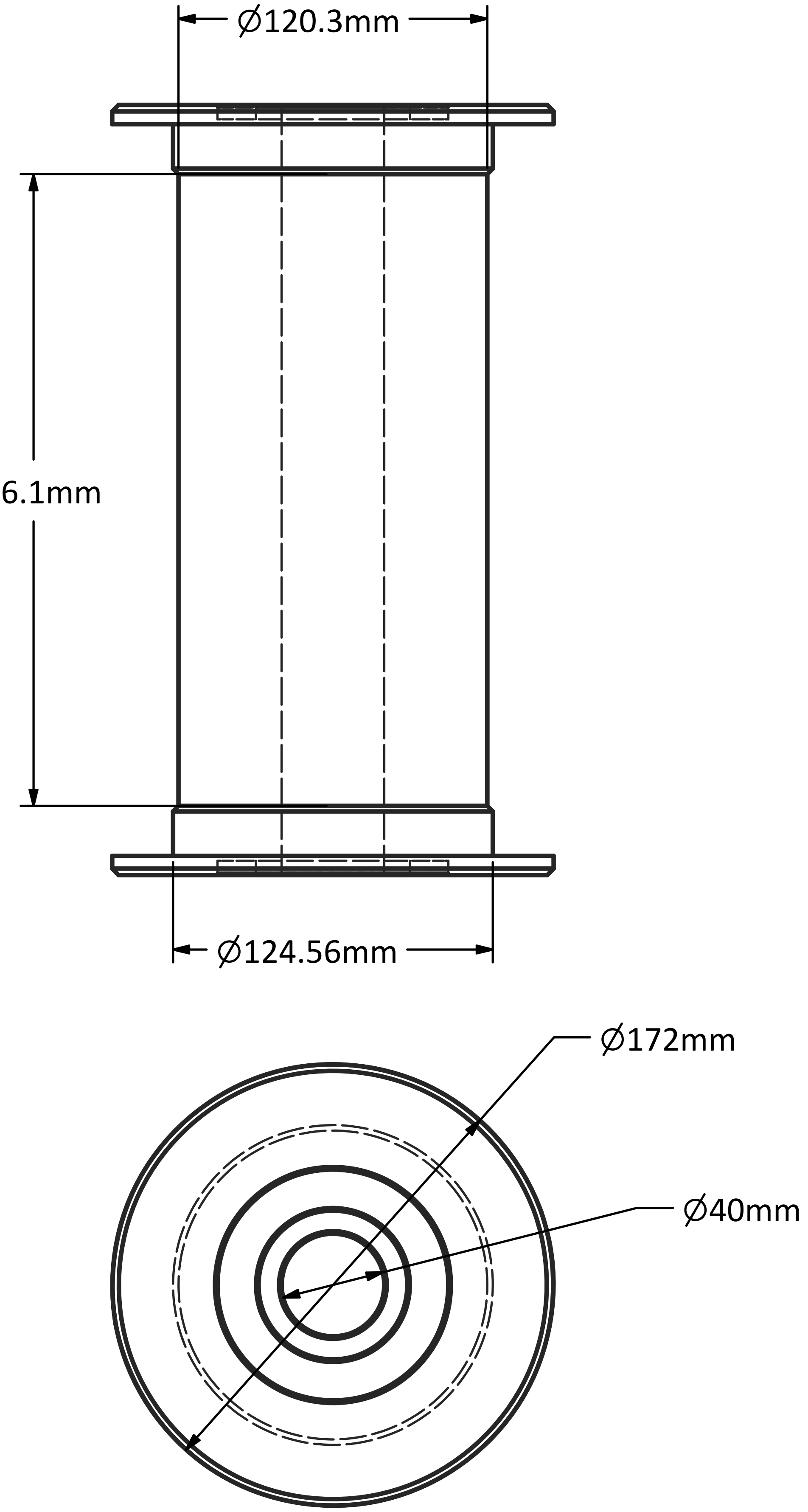


SCALE 1:5	SIZE A4	DRAWING SHEET 2	RESEARCH PROGRAM ON Roots, Tubers and Bananas



SCALE 2:5	SIZE A4	DRAWING SHEET 3

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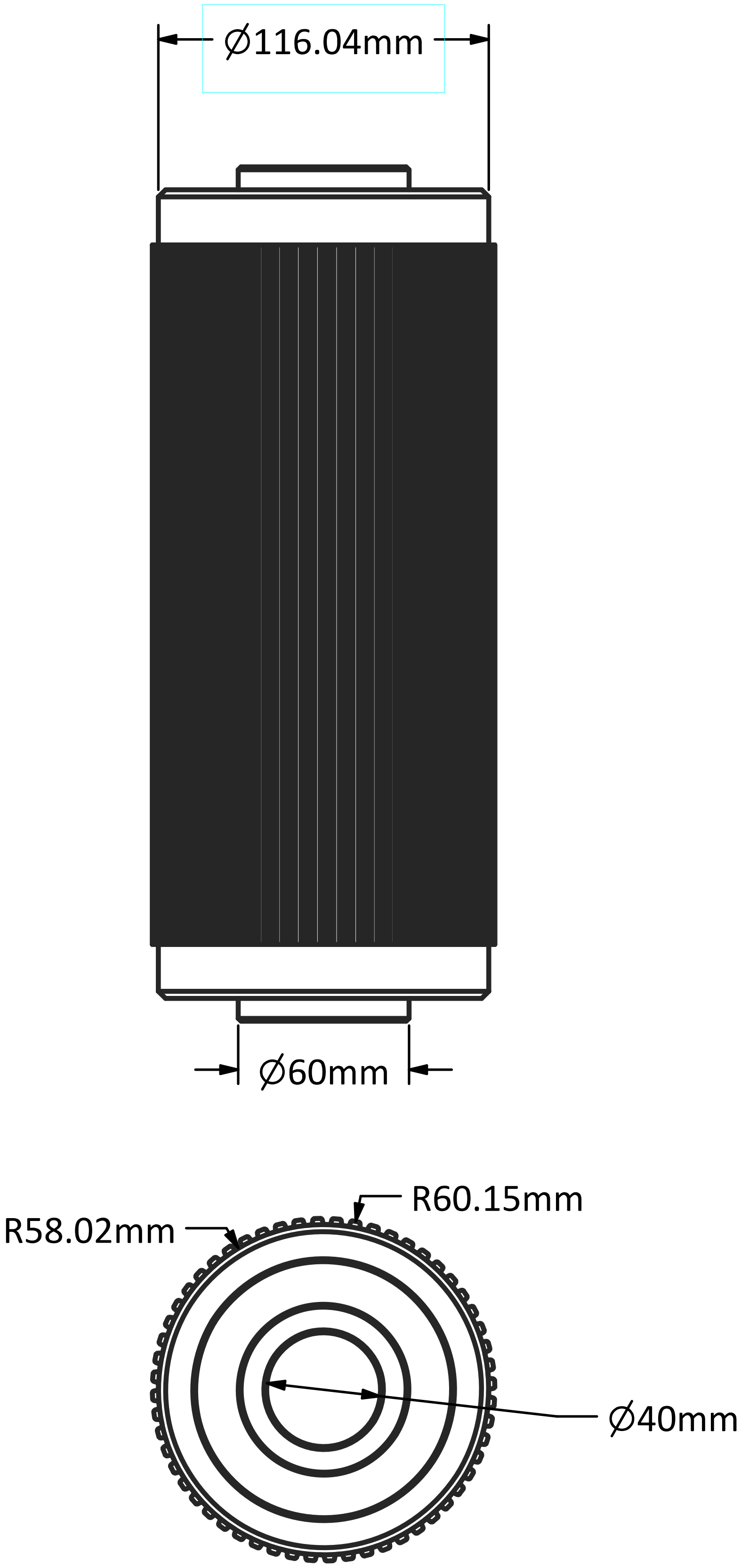

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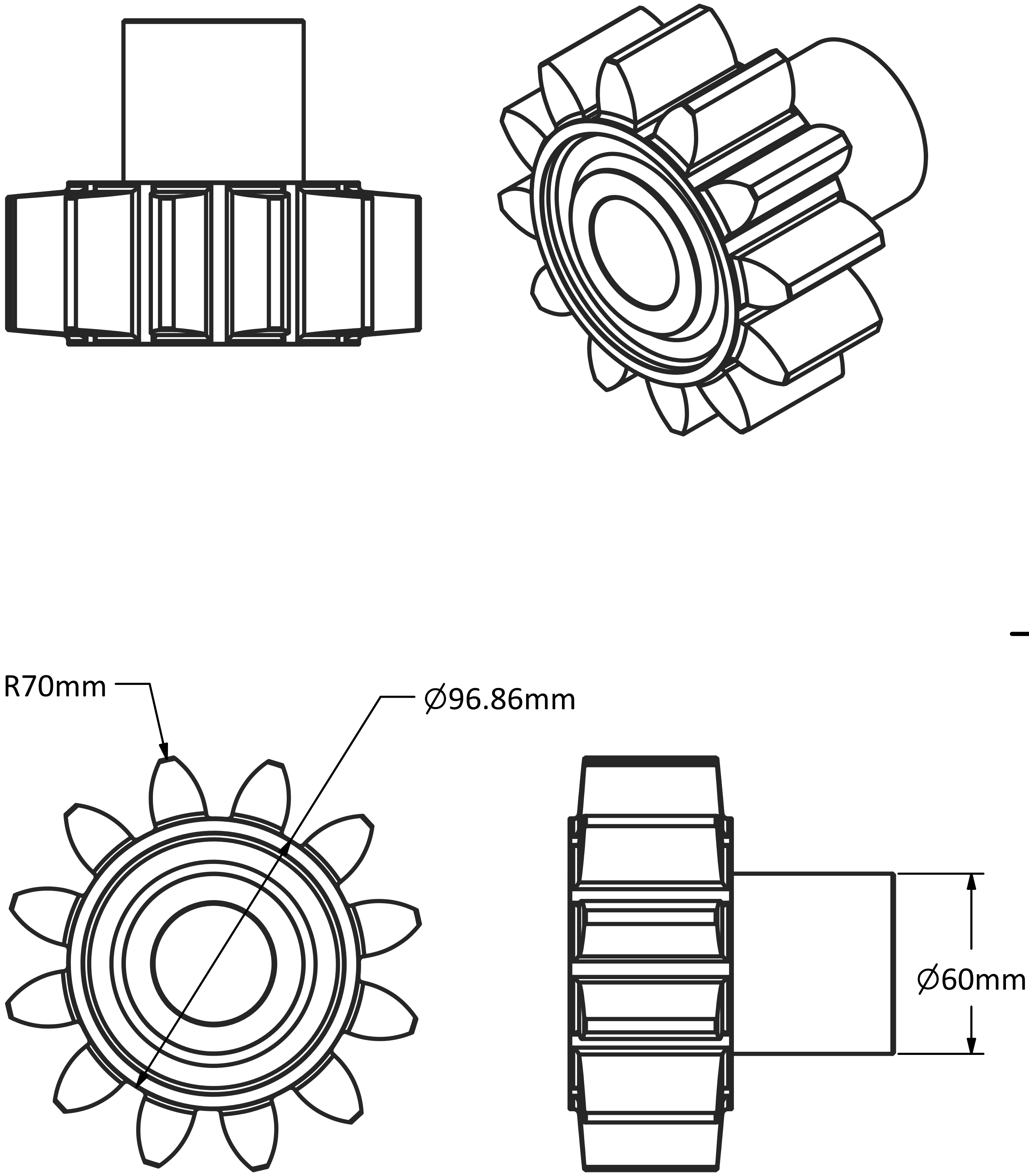

SCALE 1:2	SIZE A4	DRAWING SHEET 5

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