

**LAMPIRAN 1 (BILL OF MATERIAL)**

BOM <i>PROTOTYPE</i> MESIN PENCETAK PIRING DARI PELEPAH PINANG					
No	Part	QTY	Satuan	Harga Satuan	Harga Total
1.	Stainless Ø140 x 40,5 mm	2	pcs	560.000	1.120.000
2.	Besi UNP 50 x 38 x 2,5	6	cm	250.000	250.000
3.	Poros ST37 Ø 20	1	m	150.000	150.000
4.	Pipa Ø25	1	m	23.000	23.000
5.	Base SS 350 x 160 x 15 mm	0	0	0	0
6.	Electric Scissors jack 12V 2T	1	pcs	800.000	800.000
7.	Adaptor	1	pcs	125.000	125.000
8.	PID Rex C100 Thermostat	1	set	130.000	130.000
9.	LMK 16 UU	2	pcs	30.000	30.000
10.	Shaft Support SHF 16 mm	4	pcs	25.000	100.000
11.	Kabel AWG 3 mm Merah	4	m	10.000	55.000
12.	Kabel AWG 3 mm Hitam	4	m	10.000	100.000
13.	Mur baut	18	pcs	500.000	55.000
14.	Lain lain	-	-	-	1.500.000
<b>Total</b>					<b>4.438.000</b>

## LAMPIRAN 2 (DOKUMENTASI UJI HASIL)



Pengujian dengan suhu 80° dengan waktu tekan 20, 40, 60



Pengujian dengan suhu 100° dengan waktu tekan 20, 40, 60



Pengujian dengan suhu 120° dengan waktu tekan 20, 40, 60



Pengujian dengan suhu 120° dengan ketebalan 2 mm dan waktu tekan 20, 40, 60



Pengujian dengan menggunakan air untuk melihat kebocoran



Hasil pengujian menggunakan air didapat jika pelepah pinang kering air tidak rembes, tetapi jika pelepah pinang tidak kering air mengalami rembes

### LAMPIRAN 3 (TABEL DATA PERHITUNGAN PROSES PRODUKSI)

MATERIAL	CUTTING SPEEDS $v_c$		POINT ANGLE	LIP CLEARANCE	COOLANTS
	(METERS/MINUTE) (FEET/MINUTE)				
	MPM	FPM			
Aluminum And Alloys	61.00 - 91.50	200 - 300	90 - 130 deg	12 - 15 deg	Kerosene/Kerosene & Lard Oil/ Soluble Oil
Armor Plate	12.20 - 18.25	40 - 50	135 - 140 deg	6 - 9 deg	Light Machine Oil
Brass	61.00 - 91.50	200 - 300	118 - 118 deg	12 - 15 deg	Dry/ Soluble Oil/Kerosene/Lard Oil
Bronze	61.00 - 91.50	200 - 300	110 - 118 deg	12 - 15 deg	Dry/ Soluble Oil/Mineral Oil/Lard Oil
Bronze, High Tensile	21.35 - 45.75	70 - 150	100 - 110 deg	12 - 15 deg	Dry/ Soluble Oil/Mineral Oil/Lard Oil
Cast Iron, Soft	30.50 - 45.75	100 - 150	90 - 100 deg	12 - 15 deg	Air Jet Dry/ Soluble Oil
Cast Iron, Medium	21.35 - 30.50	70 - 100	100 - 110 deg	12 - 15 deg	Air Jet Dry/ Soluble Oil
Cast Iron, Hard	21.35 - 30.50	70 - 100	100 - 118 deg	8 - 12 deg	Air Jet Dry/ Soluble Oil
Cast Iron, Chilled	9.15 - 12.20	30 - 40	118 - 135 deg	5 - 9 deg	Air Jet Dry/ Soluble Oil
Copper	61.00 - 91.50	200 - 300	100 - 118 deg	12 - 15 deg	Air Jet Dry/ Soluble Oil
Copper Graphite Alloy (Carbon Drills)	18.30 - 21.35	60 - 70	**_**	**_**	Soluble Oil/Dry/Mineral Oil/Kerosene
Glass (Carbon Drills)	6.10 - 9.15	20 - 30	**_**	**_**	Soluble Oil/Dry/Mineral Oil/Kerosene
Iron, Malleable	15.25 - 27.45	50 - 90	90 - 100 deg	12 - 15 deg	Light Machine Oil
Magnesium And Alloys	76.25 - 122.0	250 - 400	70 - 118 deg	12 - 15 deg	Soluble Oil
Monel Nickel	4.15 - 15.28	30 - 50	118 - 125 deg	10 - 12 deg	Compressed Air/Mineral Oil
Nickel Alloys	12.20 - 18.30	40 - 60	135 - 140 deg	5 - 7 deg	Lard Oil/Soluble Oil
Plastic, Hot Set	30.50 - 91.50	100 - 300	60 - 90 deg	10 - 12 deg	Lard Oil/Soluble Oil
Plastic, Cold Set	30.50 - 91.50	100 - 300	118 - 135 deg	12 - 20 deg	Soap Solution
Steel, Low Carbon, 0.2-0.3c	24.40 - 33.55	80 - 110	110 - 118 deg	7 - 9 deg	Soap Solution
Steel, Medium Carbon 0.4-0.5c	21.35 - 24.40	70 - 80	118 - 125 deg	7 - 9 deg	Soluble Oil/Mineral Oil/Sulfur Oil/Lard Oil
Steel (High Carbon 1.2c)	15.25 - 18.30	50 - 60	118 - 145 deg	7 - 9 deg	Soluble Oil/Mineral Oil/Sulfur Oil/Lard Oil
Steel, Forged	15.25 - 18.30	50 - 60	118 - 145 deg	7 - 12 deg	Soluble Oil/Mineral Oil/Sulfur Oil/Lard Oil
Steel, Alloy	15.25 - 21.35	50 - 70	118 - 125 deg	10 - 12 deg	Mineral Lard Oil
Steel, Alloy 300 To 400 Brinell	6.10 - 9.15	20 - 30	130 - 140 deg	7 - 10 deg	Soluble Oil
Steel, Stainless, Free Machining	9.15 - 24.40	30 - 80	110 - 118 deg	8 - 12 deg	Soluble Oil
Steel, Stainless, Hard	4.57 - 15.25	15 - 50	118 - 135 deg	6 - 8 deg	Soluble Oil
Steel, Manganese	3.66 - 4.57	12 - 15	140 - 150 deg	7 - 10 deg	Soluble Oil
Stone (Carbide Drills)	7.63 - 9.15	25 - 30	**_**	**_**	Water Solution
Wood	91.50 - 122.2	300 - 400	60 - 70 deg	10 - 15 deg	Dry

Tabel 1 Data *material*, kecepatan potong, sudut mata bor HSS, dan cairan pendingin proses gurdi (Widarto, 2008)

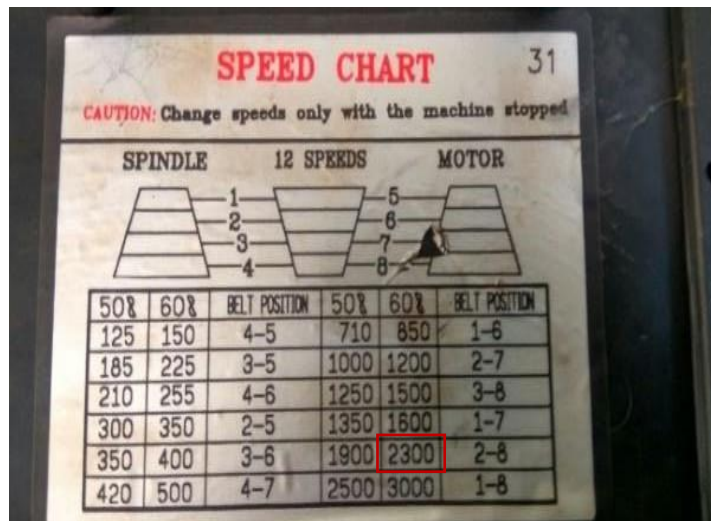
- Untuk baja

$$f = 0,084\sqrt[3]{d}; mm / put \dots \dots \dots (8.2)$$

- Untuk besi tuang

$$f = 0,1\sqrt[3]{d}; mm / put \dots \dots \dots (8.3)$$

Gambar 1 Rumus empiris gerak makan per mata potong gurdi (Widarto, 2008)



Tabel 2 Putaran Mesin Bor (Dokumentasi : Politeknik Negeri Cilacap, 2024)

MATERIAL	STRAIGHT TURNING SPEED		THREADING SPEED	
	FEET PER MINUTE	METERS PER MINUTE	FEET PER MINUTE	METERS PER MINUTE
LOW-CARBON STEEL	80-100	24.4-30.5	35-40	10.7-12.2
MEDIUM-CARBON STEEL	60-80	18.3-24.4	25-30	7.6-9.1
HIGH-CARBON STEEL	35-40	10.7-12.2	15-20	4.6-6.1
STAINLESS STEEL	40-50	12.2-15.2	15-20	4.6-6.1
ALUMINUM AND ITS ALLOYS	200-300	61.0-91.4	50-60	15.2-18.3
ORDINARY BRASS AND BRONZE	100-200	30.5-61.0	40-50	12.2-15.2
HIGH-TENSILE BRONZE	40-60	12.2-18.3	20-25	6.1-7.6
CAST IRON	50-80	15.2-24.4	20-25	6.1-7.6
COPPER	60-80	18.3-24.4	20-25	6.1-7.6

Tabel 3 Data material dan *cutting speed* proses bubut (Widarto, 2008)

**Tabel Kecepatan Potong dan Pemakanan/Putaran berdasarkan Bahan dan jenis pahat Bubut**

Material	Ballpark CS with High-Speed Tool	Cutting Speed High-Speed Tool	Cutting Speed Carbide Tool	Feed/Rev HSS Tool Lathe*	Feed/Rev Carbide Tool Lathe*
SAE 1020 - Low Carbon Steel	100	80-120	300-400	.002-.020	.006-.035
SAE 1050 - High Carbon Steel	60	60-100	200	.002-.015	.006-.030
Stainless Steel	100	100-120	240-300	.002-.005	.003-.006
Aluminum	250	400-700	800-1000	.003-.030	.008-.045
Brass & Bronze	200	110-300	600-1000	.003-.025	.008-.040
Plastics*	500	500	1000	.005-.050	.005-.050

*\*Variation in Cutting-Speed & Feed-per-Revolution will exist with different alloys, procedures, tools & desired finishes. Feed-Per-Revolution is also affected by the size of the lathe-tool, as well as the depth of cut. The cutting speed and speed of plastics will vary greatly depending upon the type of plastic.*

**Tabel 4 Feeding** mesin bubut berdasarkan bahan dan jenis pahat bubut  
(an-tika.blogspot.co.id, 2011)



**Tabel 5 Putaran** mesin bubut (Dokumentasi : Politeknik Negeri Cilacap, 2024)

## LAMPIRAN 4 LIST OF WELDING CODES DAN SIMBOL PENGELASAN

### List of welding codes

#### **American Society of Mechanical Engineers (ASME) Codes**

The [American Society of Mechanical Engineers \(ASME\) Boiler and Pressure Vessel Code \(BPVC\)](#) covers all aspects of design and manufacture of boilers and pressure vessels. All sections contain welding specifications, however most relevant information is contained in the following:

<b>Code</b>	<b>Description</b>
ASME BPVC Section II	Part C: Specifications for Welding Rods, Electrodes, and Filler Metals. <sup>14</sup>
ASME BPVC Section V	Nondestructive Examination
ASME BPVC Section IX	Welding and Brazing Qualifications Buttwelding ends
ASME B16.25	magi

#### **American Welding Society (AWS) Standards**

The [American Welding Society \(AWS\)](#) publishes over 240 AWS-developed codes, recommended practices and guides which are written in accordance with American National Standards Institute (ANSI) practices.<sup>21</sup> The following is a partial list of the more common publications:

<b>Standard Number<sup>1</sup></b>	<b>Title</b>
AWS A02.4	Standard symbols for welding, brazing, and non-destructive examination
AWS A03.0	Standard welding terms and definitions
AWS A05.1	Specification for carbon steel electrodes for shielded metal arc welding
AWS A05.18	Specification for carbon steel electrodes and rods for gas shielded arc welding
AWS B01.10	Guide for the nondestructive examination of welds
AWS B02.1	Specification for Welding Procedure and Performance Qualification
AWS D01.1	Structural welding (steel)
AWS D01.2	Structural welding (aluminum)
AWS D01.3	Structural welding (sheet steel)
AWS D01.4	Structural welding (reinforcing steel)
AWS D01.5	Bridge welding
AWS D01.6	Structural welding (stainless steel)
AWS D01.7	Structural welding (strengthening and repair)
AWS D01.8	Structural welding seismic supplement
AWS D01.9	Structural welding (titanium)
AWS D08.1	Automotive spot welding
AWS D08.6	Automotive spot welding electrodes supplement
AWS D08.7	Automotive spot welding recommendations supplement
AWS D08.8	Automotive arc welding (steel)
AWS D08.9	Automotive spot weld testing
AWS D08.14	Automotive arc welding (aluminum)
AWS D09.1	Sheet metal welding
AWS D10.10	Heating practices for pipe and tube

Gambar 1. AWS Welding Codes (Of & Codes, 2023)

Standard Number <sup>1</sup>	Title
AWS D10.11	Root pass welding for pipe
AWS D10.12	Pipe welding (mild steel)
AWS D10.13	Tube brazing (copper)
AWS D10.18	Pipe welding (stainless steel)
AWS D11.2	Welding (cast iron)
AWS D14.1	Industrial mill crane welding
AWS D14.3	Earthmoving & agricultural equipment welding
AWS D14.4	Machinery joint welding
AWS D14.5	Press welding
AWS D14.6	Industrial mill roll surfacing
AWS D15.1	Railroad welding
AWS D15.2	Railroad welding practice supplement
AWS D16.1	Robotic arc welding safety
AWS D16.2	Robotic arc welding system installation
AWS D16.3	Robotic arc welding risk assessment
AWS D16.4	Robotic arc welder operator qualification
AWS D17.1	Aerospace fusion welding
AWS D17.2	Aerospace resistance welding
AWS D18.1	Hygienic tube welding (stainless steel)
AWS D18.2	Stainless steel tube discoloration guide
AWS D18.3	Hygienic equipment welding

<sup>1</sup>The zero after the first letter is only placed there so the table can be sorted. i.e. D01.1 is actually D1.1).

**Gambar 2. AWS Welding Codes (Of & Codes, 2023) (lanjutan)**



## International Organization for Standardization (ISO) Standards























[International Organization for Standardization \(ISO\)](#) has developed over 18500 standards and over 1100 new standards are published every year.<sup>24</sup> The following is a partial list of the standards specific to welding:

Standard Number	Description
ISO 2553	Welded, brazed and soldered joints - symbolic representation on drawings (1992)
ISO 2560	Welding consumables. Covered electrodes for manual metal arc welding of non-alloy and fine grain steels. Classification
ISO 3580	Covered electrodes for manual arc welding of creep-resisting steels - Code of symbols for identification
ISO 3581	Covered electrodes for manual arc welding of stainless and other similar high alloy steels - Code of symbols for identification
ISO 3834	Quality requirements for fusion welding of metallic materials, five parts.
ISO 4063	Welding and allied processes - Nomenclature of processes and reference numbers
ISO 5817	Welding. Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded). Quality levels for imperfections
ISO 6520-1	Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding
ISO 6520-2	Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 2: Welding with pressure
ISO 6947	Welds. Working positions. Definitions of angles of slope and rotation
ISO 9606	Qualification test of welders — Fusion welding, parts 1 to 5
ISO 9692-1	Welding and allied processes. Recommendations for joint preparation. Manual metal-arc welding, gas-shielded metal-arc welding, gas welding, TIG welding and beam welding of steels
ISO 9692-2	Welding and allied processes. Joint preparation. Submerged arc welding of steels
ISO 9692-3	Welding and allied processes. Joint preparation. Part 3: TIG and MIG welding of aluminium and its alloys
ISO 13847	Petroleum and natural gas industries - <a href="#">Pipeline transportation systems</a> - Welding of pipelines
ISO 13916	Welding - Guidance on the measurement of preheating temperature, interpass temperature and preheat maintenance temperature
ISO 13918	Welding - Studs and ceramic ferrules for arc <a href="#">stud welding</a>
ISO 13919-1	Welding - Electron and laser-beam welded joints - Guidance on quality level for imperfections - Part 1: Steel
ISO 13919-2	Welding - Electron and laser-beam welded joints - Guidance on quality level for imperfections - Part 2: Aluminium and its weldable alloys
ISO 13920	Welding - General tolerances for welded constructions - Dimensions for lengths and angles - Shape and position
ISO 14112	Gas welding equipment - Small kits for gas brazing and welding
ISO 14175	Welding consumables — Gases and gas mixtures for fusion welding and allied processes. Replaced EN 439:1994 in Europe.
ISO 14341	Welding consumables. Wire electrodes and deposits for gas shielded metal arc welding of non alloy and fine grain steels. Classification
ISO 14554	Resistance welding

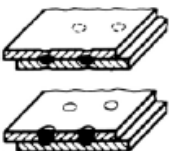

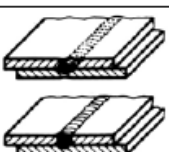

**Gambar 3. ISO Welding Codes (Of & Codes, 2023) (lanjutan)**

Standard Number	Description
ISO 14744	Electron beam welding, six parts
ISO 15607	Specification and qualification of welding procedures for metallic materials - General rules
ISO/TR 15608	Welding - Guidelines for a metallic material grouping system
ISO 15609	Specification and qualification of welding procedures for metallic materials - Welding procedure specification, five parts.
ISO 15610	Specification and qualification of welding procedures for metallic materials — Qualification based on tested welding consumables
ISO 15611	Specification and qualification of welding procedures for metallic materials — Qualification based on previous welding experience
ISO 15612	Specification and qualification of welding procedures for metallic materials — Qualification by adoption of a standard welding procedure
ISO 15613	Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test
ISO 15614	Specification and qualification of welding procedures for metallic materials - Welding procedure test, 13 parts.
ISO 15615	Gas welding equipment. Acetylene manifold systems for welding, cutting and allied processes. Safety requirements in high-pressure devices
ISO 15618-1	Qualification testing of welders for under-water welding. Diver-welders for <a href="#">hyperbaric</a> wet welding
ISO 15618-2	Qualification testing of welders for under-water welding. Diver-welders and welding operators for <a href="#">hyperbaric</a> dry welding
ISO 17635	Non-destructive testing of welds. General rules for metallic materials
ISO/TR 20172	Welding — Grouping systems for materials — European materials
ISO/TR 20173	Welding — Grouping systems for materials — American materials
ISO/TR 20174	Welding — Grouping systems for materials — Japanese materials
ISO 24394	Welding for aerospace applications. Qualification test for welders and welding operators. Fusion welding of metallic components

**Gambar 4. ISO Welding Codes (Of & Codes, 2023) (lanjutan)**

NO.	JENIS LASAN	ILUSTRASI	SIMBOL
1.	Las tepi		
2.	Las tumpul I		
3.	Las tumpul - V tunggal		
4.	Las lancip tunggal		
5.	Las tumpul - V tunggal dengan kaki		
6.	Las lancip tunggal dengan kaki		
7.	Las tumpul – U tunggal		
8.	Las tumpul – J tunggal		
9.	Las penguat belakang		
10.	Las sudut		
11.	Las sumbat		

Tabel II - 1 Simbol Dasar

NO.	JENIS LASAN	ILUSTRASI	SIMBOL
12.	Las titik		
13.	Las kampuh		

Tabel II -1 Simbol Dasar (lanjutan)

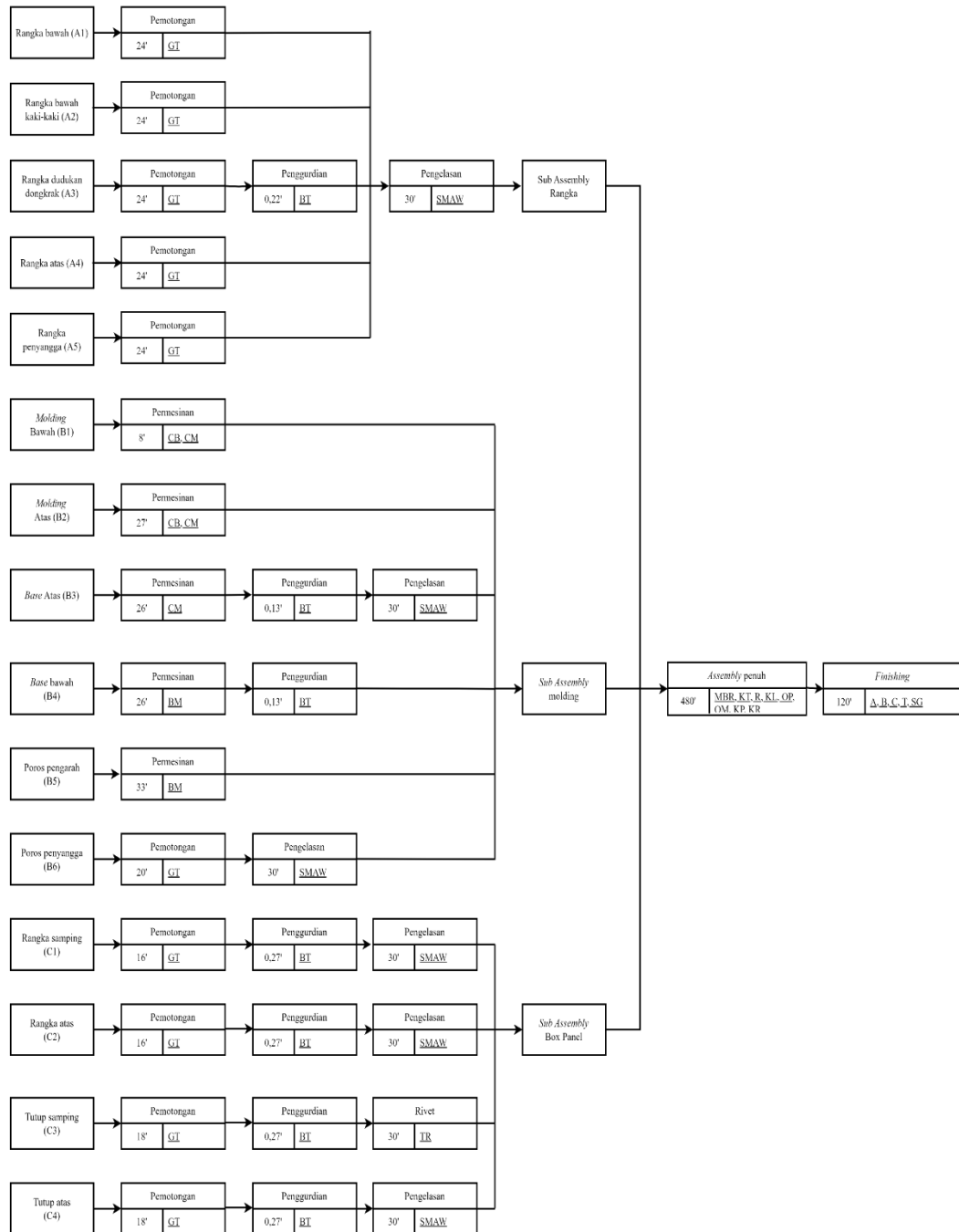
**Gambar 5. Simbol Dasar Pengelasan**

## LAMPIRAN 5 (DOKUMENTASI PROSES PEMBUATAN)





## LAMPIRAN 6 *FLOW OF PROCESS* PRODUKSI *PROTOTYPE* MESIN PENCETAK PIRING DARI PELEPAH PINANG



**Keterangan :**  
 GT : Gerinda Tangan    CB : CNC Bubut    TR : Tang Rivet    KL : Kunci L    KR : Kunci Ring    B : Brush    T : Thinner  
 CM : CNC Milling    BM : Bubut Manual    MBR : Mur, Baut, Ring    OP : Obeng Plus    KP : Kunci Pas    D : Dempul    Sg : Spray Gun  
 BT : Bor Tangan    SMAW : Mesin Las SMAW    KT : Kabel Tis    OM : Obeng Min    A : Amplas    C : Cat

**LAMPIRAN 7 *FULL ASSEMBLY PROTOTYPE* MESIN PENCETAK  
PIRING DARI PELEPAH PINANG**



**LAMPIRAN 8**  
**(BIODATA PENULIS)**



Nama : Fiqih Indrayanto Putra  
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NIM : 210103011  
Prodi : D3-Teknik Mesin  
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e-mail : Fiqihindrayanto.putra10@gmail.com  
Hobi : Mancing dan silat  
Motto : Hidup hanya untuk mati

**Riwayat Pendidikan:**

1. SDN Drengges 4 kertosono : Tahun 2007-2013
2. SMP Negeri 4 kertosono : Tahun 2015-2018
3. SMK Taruna Bakti Kertosono: Tahun 2018-2021