Journal of Automotive Engineering Technology

ISSN (Print) XXXX-XXXX ISSN (Online) XXXX-XXXX

Article Category

Perancangan Meja Welding Fixture Portable dengan Fitur Tilt and Lock untuk Fabrikasi Behel Belakang Sepeda Motor

Aldino Subarkah Prastya[1], Marcelino Simanjuntak[2], Adil Triyulis[3], Ridho Hans Gurning[*]

[1,2,3,4,*] *Teknologi Rekayasa Otomotif, Politeknik STMI Jakarta, Jakarta Pusat, Indonesia*

ARTICLE INFO

Received : 1 Desember 2025
Revised : 15 Desember 2025
Accepted : 30 November 2025

KEYWORDS

Welding Fixture, Design, Bracket, Manufacturing, CAE

KORESPONDENSI

E-mail Correspnding Author:
ridhohans@stmi.ac.id

A B T R A C T

Manufacturing motorcycle rear brackets requires high dimensional accuracy to ensure precise bolt mounting holes when installed on the vehicle frame. Inaccurate joint positioning during manual welding often leads to heat distortion and product defects. This study designed a portable welding fixture table that functions as a jig and fixture to rigidly lock the bracket pipe structure. The main table plate dimensions are designed at 24 x 20 inches with a zinc-plated steel surface to optimize electrical conductivity and corrosion resistance. To improve ergonomics, the table is equipped with a tilt and lock mechanism at 0°, 30°, and a folded position, as well as telescopic legs for height adjustment. Additional features such as guide rails and a lower storage shelf are integrated to improve work efficiency in the workshop. The design results show that the table structure can support loads of up to 158 kg with a stable caster wheel mobility system, thus ensuring a more accurate and efficient motorcycle bracket manufacturing process.

INTRODUCTION

Industry manufacturing component automotive scale medium, especially in manufacturing accessories stirrup behind motorbike, demanding precision high on each point connection. At the stage welding, challenges main issues faced is emergence strain residual and distortion form consequence heat that is not evenly. Without tool help adequate clamp, steel pipe compiler stirrup tending curved, so that position hole bolt No will symmetrical with motorcycle frame.

Study This aim develop A table flexible modular welding fixture. Different with conventional static welding table, design This prioritizes aspect portability and setup corner ergonomic work. Use system hole 19 mm matrix and plate material special expected capable give solution for practitioners manufacturing and minimizing disabled production and speed up time assembly motorcycle brackets.

METHOD

1.1. Context Industry Manufacturing Indonesian Automotive

Industry manufacturing component automotive in Indonesia, especially on the scale of Small and Medium Enterprises (SMEs) and industry medium, experienced significant growth in the last decade. Sector This contributes important against economy national and absorption power work, especially in production accessories after-sales vehicle motorized. One of the products continued excellence develop is stirrup behind motorbike, which is important structural components for comfort and safety passenger.

Stirrup the back of the motorbike is not just element aesthetics, but rather own function critical technical components This functioning as handle passenger, support burden dynamic, and connecting structural between frame main with system suspension behind. Therefore that, accuracy dimensions and quality connection become a quality parameter that is not can compromised. Incompatibility dimensions as big as a number of millimeter just can cause product No can installed with perfect on the frame vehicles, which ultimately produce high reject rate and losses financial for manufacturer.

1.2. Technical Challenges in Manual Welding Process

Manual welding process is the most common method used in workshops scale small and medium Because cost relative investment low and flexible in handle various geometry product . However , this process own a number of challenge significant technical issues . When the welding arc touches the steel pipe material , the energy heat generated reach te mperature more from 3000°C, causing expansion thermal local to the material.

Without existence system rigid and precise gripping , phenomenon expansion thermal This trigger emergence voltage residual stress and distortion significant shape . Pipes tend to curved , shifted , or changed dimensions from coordinate the design during the welding process ongoing . Phenomenon This known as heat distortion or thermal warping, and is one of the reason main disabled production in industry manufacturing.

Study previously show that distortion thermal can cause change dimensions up to 5-10 mm on components with length 500 mm, depending on welding parameters and materials used . Mismatch This result in product No can mounted on the motorcycle frame , so that must processed repeat or even thrown away as waste production.

1.3. The Role of Jigs and Fixtures in manufacturing Precision

This use approach design get up table *fixture* that begins with identification room Work For various type motorcycle brackets . The main material chosen for work panel is steel with layer protector zinc (*zinc plating*) which aims For ensure contact stable *grounding* during the arc welding process .

Stages design focused on three feature main : system modular clamping mechanism slope table , and system mobility . Technical parameters like capacity burden maximum (158 kg) and range height table (660 mm – 810 mm) tested through capitalization structure . In addition that , integration rack storage in the lower frame designed For make it easier operator

https://doi.org/10.52330/jaet.v1i2.618

access to equipment supporters like clamp , hammer silver , and machines grinder .

Table 1. Static Loading Result Data on Structure Table *Welding Fixture*

Material	*Force* (N)	*Plain Stress* (MPa)	Plain Strain
Structural Steel (Zinc Plated)	1550	14.25	7.12 x 10- ^{5}
Alloy Steel (Pin)	1550	18.60	8.85 x 10 $^{-5}$
*Carbon Steel (*telescopic legs)	1550	12.10	6.05 x 10 $^{-5}$

- The maximum load that can be detained table is 158 kg. Static gravity is calculated with multiply mass object (*m*) with acceleration gravity earth ($g = 9.81\ m/s^2$). With calculation like as follows :

  F = m x g (1)

  F = 158 kg x 9.81 m/s ^{2}

  F = 1550 N

Hole Diameter	Tabletop Thickness	Table Height Range	Table Positions	Load Capacity	Weight
19 mm	12 mm	660-810 mm	10°, 30°, Folded	158 kg	xxx

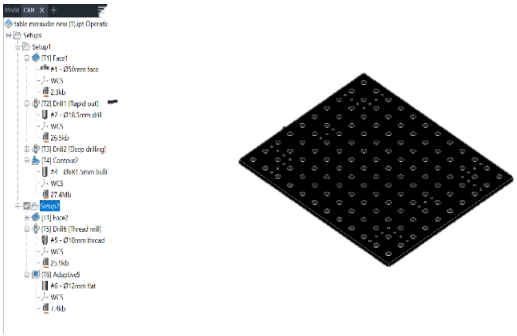


Fig 1. Specifications & Drawings

- Based on standard foot material telescopic , assumed wide cross section effective (*A*) profile steel carbon that receives burden pressure is 128 mm ^{2}. This value must converted to in unit standard international (m ^{2}).

  A = 128 mm ^{2} x 10 $^{-6}$ m ^{2} (2)
  A = 0.000128 m ^{2}



Fig 2. *Jig & Fixture Feet*

https://doi.org/10.52330/jaet.v1i2.618

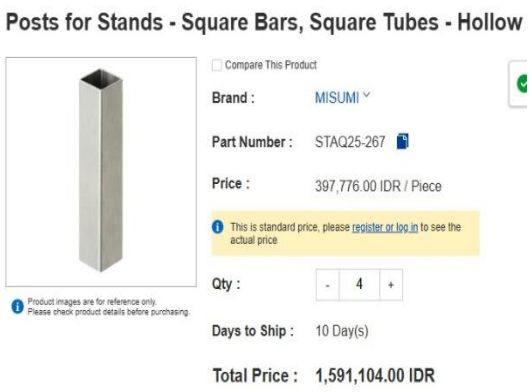


***Fig 3**. Jig Leg & Fixture Specifications*

Type Details	Square	End Shape (Left)	Straight
End Shape (Right)	Straight	Outer Dia. D	25
Material	[Stainless Steel] SUS304	Wrench Flats B (or D)	25
Surface Treatment	Not Provided	Post Type	Hollow
Scale	Without Scale	Length L	267
Pilot (Concave-Convex at End)	Not Provided	Shape	Square Tubes
RoHS	10	-	-

***Fig 4.** Foot size type*



***Fig 5**. Jig & Fixture leg*

specifications

Basic Shape	Hollow	End Shape (Left)	No Machining
End Shape (Right)	No Machining	Material	[Steel] SUJ2 Equivalent
Heat Treatment	Induction Hardened	Surface Treatment	Not Provided
Shaft Dia. D	25	Length L	640
Shaft Fit Tolerance	g6	Hardness	Induction Hardened (58HRC~)
RoHS	10	-	-

***Fig 6**. Foot size type*

- Normal Stress is calculated For know how much big internal force of unity material wide in withhold burden .

$$\sigma = \frac{F}{A} (3)$$

https://doi.org/10.52330/jaet.v1i2.618

$$\sigma = \frac{15550\ N}{0.000128\ m2}$$

σ = 12,109,375 N/m ^{2}

Since 1 MPa = 1,000,000 N/m ^{2} , then the voltage that occurs is ;

$$\sigma = 12.10\ MPa$$

- Stretch counted For know level deformation elastic material. Referring to *Hooke's* Law , the value of the Elastic Modulus (*E*) for steel standard structural carbon is around 200 GPa or 200,000 MPa.

$$€ = \frac{\sigma}{E}(4)$$

$$€ = \frac{12.10\ MPa}{200.000\ MPa}$$

€ = 6.05 x 10 $^{-5}$

1. Results and Discussion

- **Work Panel and System Specifications Strangulation**

  Plate table own dimensions 24x20 inches with designed thickness For subside vibration and heat . All surface table coated with functional *zinc* plating double : prevent adhesion welding spatter as well ensure flow current strong grounding without obstacles . Table This own pattern hole precision 19 mm in diameter which allows installation clamp clamps (*F-clamps*) and rails guides (*guide rails*) in a way flexible . Guide rail this is very useful For ensure the braces pipe be at an angle upright consistent straight before done welding point (*tack weld*) .

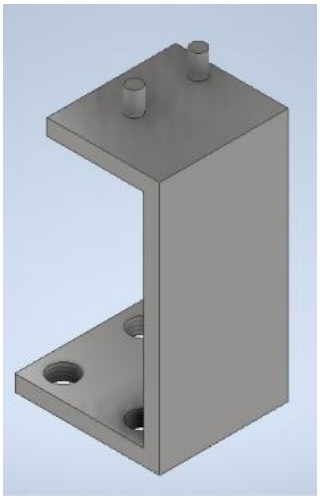


***Fig 7**. Locating Pin*

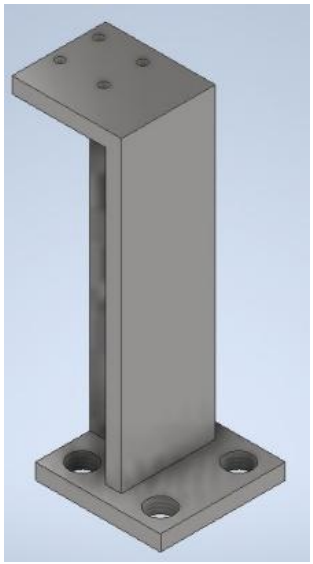


***Fig 8**. Locator Clamp*

https://doi.org/10.52330/jaet.v1i2.618

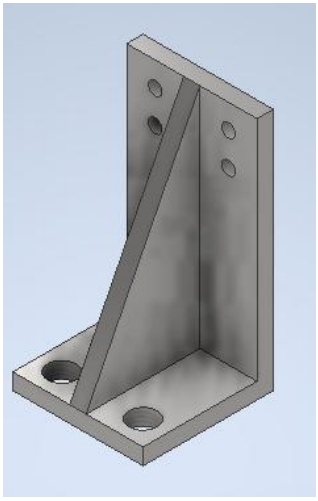


***Fig 9** . Locator ikel 1*

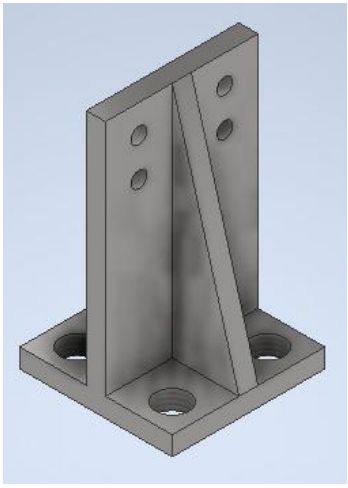


***Fig 10.** locator ikel 2*

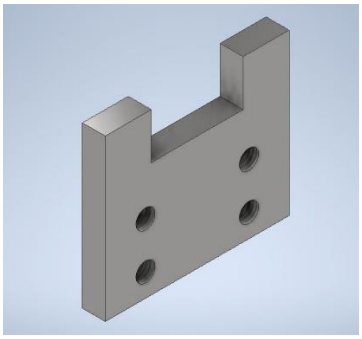


***Fig 11**. Locator head 1*

https://doi.org/10.52330/jaet.v1i2.618

RESULT AND DISCUSSION

2. Specifications of Work Panel and Clamping System

The table plate measures 24x20 inches and is designed to absorb vibration and heat [cite: 315]. The entire table surface is coated with zinc plating, which serves a dual purpose: preventing welding spatter and ensuring a strong, unimpeded flow of grounding current [cite: 316]. The table features a precision-drilled 19 mm hole pattern that allows for flexible installation of F-clamps and guide rails [cite: 317]. These guide rails are essential for ensuring the stirrup pipe is at a consistent, straight, perpendicular angle before tack welding.

3. Tilt Mechanism and Height Adjustment

Working position flexibility is achieved through a 3-position tilt feature controlled by a T-shaped locking lever (T-Handle). Operators can adjust the table tilt to 0° for flat work or 30° to reach the curved underside of braces without having to change their standing position [cite: 320]. Furthermore, the table legs utilize a telescopic system with locking pins that allow for multiple levels of height adjustment, adapting to the operator's posture.
The height from the product surface to the bottom support is available in several comfortable levels: 1 meter (below elbow level), 94 cm (waist level), and 87 cm (thigh level).

4. Workspace Management and Mobility

To support productivity in limited workshop space, this table features a spacious lower storage shelf [cite: 323]. This shelf can accommodate a variety of work tools, keeping the table surface clean and focused on the workpiece [cite: 324]. On the edge of the table, there are special side slots that can be used to store hand tools for easy access [cite: 325]. Tool mobility is supported by the use of heavy-duty caster wheels on both sides of the table legs [cite: 326]. These wheels are equipped with a leg locking mechanism to ensure the table does not shift when subjected to pressure from the clamping process [cite: 327]. The entire main frame is connected using a quick-release mounting system that allows the table to be disassembled and folded into a compact form when not in use [cite: 328].

4. Grounding and safety

Arc strike defects can be avoided because this table provides a wide ground contact point [cite:329]. The welding machine's ground cable can be clamped to any conductive edge of the table plate [cite:330]. With strong vertical clamping pressure, the motor bracket will adhere tightly to the table plate, ensuring a stable welding arc and reducing the risk of excessive spatter [cite:

331].**CONCLUSION**

Design results show that table *welding* this *fixture* is solution effective For manufacturing motorcycle braces . Use layer *zinc plated* increases quality welding through delivery more electricity good and longer material durability . *Tilt and lock features* as well arrangement tall give comfort significant ergonomics for operators. With capacity load 158 kg and system storage integrated , table This No only ensure precision product motorcycle braces , but also creates environment more work neat and efficient.

REFERENCES

Arnaoutis, V., Rosi, B. V., & Lutters, E. (2023). Automated design evolution for parametric design applied on computer-aided welding fixture designs. Procedia CIRP, 119, 999–1004. https://doi.org/10.1016/j.procir.2023.03.143

For, D., et al. (2025). Faculty of Industrial Technology.

Gurning, R. H., & Riadi, A. (2022). Dwelling time analysis using dynamic system model in the implementation of National Logistics Ecosystem at Port Jakarta International Container Terminal. Omni-Akuatika, 18(S1), 8–13.

https://doi.org/10.52330/jaet.v1i2.618

Hoffmeyer, F., Raulf-Heimsoth, M., & P. Welding. (2021). Design of fixtures for welding. https://doi.org/10.1088/1757-899X/1163/1/012007

Jha, N. K., & B., R. P. (n.d.). Design and analysis of welding fixture for elementary weld joints. https://doi.org/10.32377/cvrjst1516

Nasrullah, B., Mihdar, U. H., Harmi, N., Pasau, H. B., & Nursyam, M. (2024). Development of CNC spot welding machine control and precision system for battery pack assembly. 22(2), 312–318.

Palesa, S., Ilesanmi, A., Elvis, P., & Walter, T. (2026). Performance evaluation of a smart welding fixture and jig assembly.

Qcc, M., & Persero, I. (2025). Analysis of defect level of end wall components using. 10(2), 502–514.

Riyadi, E. S., & Kusumawati, E. (2022). Design and construction of a sliding cutting jig to optimize the working function of a hand grinder as a sheet metal cutting tool. 4(2), 82–89.

Rizka, H., Matahelumual, M., Noer, M. T., & Heryana, G. (2024). Redesign of plate grip tool in the context of jig and fixture in welding process on workbench. Jurnal Mekanik Terapan, 5(2), 113–120. https://doi.org/10.32722/jmt.v5i5.6545

Safril, S., Azmi, W. H., Mohd Zawawi, N. N., & Ramadhan, A. I. (2023). Tribology performance of TiO_2-SiO_2/PVE nanolubricant at various binary ratios for the automotive air-conditioning system. Automotive Experiences, 6(3), 485–496. https://doi.org/10.31603/ae.10255

Safril, S., Imansuri, F., Sumasto, F., & Wirandi, M. (2022). Feasibility study of biomass power generation system using comparison analysis. Proceedings of the 4th Asia Pacific Conference on Research in Industrial and Systems Engineering (APCORISE 2021). https://doi.org/10.1145/3468013.3468660

Safril, S., Siregar, M. I. H. M., Wirandi, M., & Setiawan, D. (2021). Desain dan simulasi uji tekan pada jigs pin piston diameter Ø13 mm. APTEK, 13(2), 75–82. https://doi.org/10.30606/aptek.v13i2.819

Safril, S., Sumasto, F., Wirandi, M., & Imansuri, F. (2020). Simulation of generate value for development of biomass plants in Indonesia: A feasibility study. IOP Conference Series: Materials Science and Engineering, 885(1), 012026. https://doi.org/10.1088/1757-899X/885/1/012026

Safril, S., Wan Hamzah, W. A., & Mustakim. (2025). Investigation of different compressor speeds to improve the performance of residential air conditioning system using hybrid nanolubricant. Journal of Mechanical Engineering and Sciences, 19(1), 10554–10564. https://doi.org/10.15282/jmes.19.1.2025.10.0827

Safril, S., Wirandi, M., Sumasto, F., Imansuri, F., Fauzi, W., & Aji, R. M. P. (2024). Improvement productivity analysis in the application of electro-pneumatic for production of automotive components. AIP Conference Proceedings, 3093(1), 070001. https://doi.org/10.1063/5.0248567

Seloane, W. T., Mpofu, K., Ramatsetse, B. I., & Modungwa, D. (2023). Conceptual design of intelligent reconfigurable welding fixture for rail car manufacturing industry. Procedia CIRP, 91, 583–593. https://doi.org/10.1016/j.procir.2020.02.217

Shalihah, A. R., Subarkah, A. B., Novyansyah, F., Fadillah, I., Muhadzab, A. F., Alfath, H. M., et al. (2026). Evaluation of injection molding process parameters on the quality of brake fluid reservoir cap products using Moldflow simulation. Otopro, 78–84.

Solih, E. S., Purbaningrum, S. P., Nurhadi, F. F., Agustin, D., & Fauzi, W. (2025). Dasar-dasar ilmu bahan dalam dies stamping dan mold. CV Eureka Media Aksara.

Widodo, A., Revandi, M., Arlianto, P. Y. D., Ihsan, M. A., Abdullah, F., & Prasetyo, R. (2025). Development of an adjustable welding table for welding needs in a production workshop at PT Envicon Ekatama using the French method. 12.

You, A., Be, M., & In, I. (2024a). Conceptual design of modular fixture for frame welding.

You, A., Be, M., & In, I. (2024b). Welding fixture design for the production of cross-flow.

Zuo, Q., Zhang, Y., Huang, S., & Chen, C. (2022). Structural design of high-precision fixture for laser welding: A review. Journal of Advanced Manufacturing Science and Technology, 2(3), 1–10. https://doi.org/10.51393/j.jamst.2022013