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PRODUCTION PROCESS OF 60 FT UGL ROLLERS ON FLAT TOP (CFT) WAGON CONTAINER TYPE TRAINS AT PT. INDUSTRIAL TRAIN

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***Abstract*:** A train is a form of rail transportation consisting of a series of vehicles pulled along a railroad track to transport cargo or passengers. There are different types of trains designed for specific purposes. A train may consist of a combination of one or more locomotives and attached railcars, or several self-propelled units (or sometimes a single or articulated powered coach, called a railcar). To move the train, a component called a bogie is needed. Bogies are generally used for wheels with more than 2 axles (As) in one train car. One of the bogie components found on a train is a bolster. The function of the bolster is to support the bogie against the train body. In making UGL 60 FT bolsters, it begins with material preparation. The materials used are S690Q steel with a tensile strength of 690 MPa, S355J2+N steel with a tensile strength of 355 MPa and E235 steel pipe with a tensile strength of 235 MPa. After that, it enters the cutting process, namely the process of cutting plate-shaped material using a plasma cutting machine and cutting steel pipes with a bandsaw machine, then the chamfering process, which is the process of cutting corners to form a chamfer with an angle of 0 - 90 degrees, after that the Bending process, namely the process of bending on one of the bolster components, then the assembly process, namely the process of connecting a single part of the bolster and continuing the welding process using a 350 ampere GMAW welding machine, and the last is the Quality Control (QC) process, namely the material testing process using the Non Destructive Test (NDT) method. in the form of Magnetic Test (MT) and Visual Test (VT) testing. Quality Control (QC) is carried out to check the feasibility of an object being produced. If there is a workpiece that is not good then the workpiece will be repaired again. And if the workpiece is said to be feasible, it will be brought to the assembly process in the assembly division.
***Keyword*:** Containers, Production, Train

INTRODUCTION

A bogie is a construction consisting of two or more sets of wheels combined by a frame equipped with a springing, braking system, with or without propulsion and anti-slip equipment, and overall functions as a support for the basic frame of the train body. The main function of bogies is to provide flexibility for the train on the rails so that the wheels can follow the direction of the rails when passing through bends (curves). When a train passes a banked or curved rail, an angle will occur between the straight line of the train body and the rail. In this situation, there will be contact between the flange and the rail on one side of the wheel. With a bogie, the wheels are not in line with the train body but have a certain angle that allows the wheels to turn along the rails without derailing or the wheels rising onto the rails. The bogie can be removed and reattached if maintenance is being carried out. Apart from flexibility, bogies can also reduce the effects caused by rails that wave up and down. The middle point of the bogie which is called "Center Pivot" will divide the deflection that occurs between the 2 wheels. This will cause the train to be more stable even if the rails are uneven/bumpy up and down[1].

Train bogies can be classified into two, namely bogies with bolsters and bogies without bolsters (BOLSTERLESS bogies), bogies with bolsters act as a support for the bogie against the train body. On the bolster there is a pivot, which is the center point of rotation of the bogie as well as the connection between the train body and the bogie. Usually bogies with bolsters have simpler construction because they generally only consist of one level of springing. This is because bogie bolsters do not really prioritize comfort. An example of using bogies with bolsters is on goods trains. In BOLSTERLESS bogies, the frame will be connected to the train body. The secondary spring rests directly on the frame and is connected to the carriage body. The secondary spring can be a thread spring or an air spring. In BOLSTERLESS bogies for Passenger Trains, KRD and KRL generally use air springs to more optimally dampen vibrations thereby increasing comfort for passengers [2].

A train bogie with bolsters consists of several main parts, including: bogie frame, bolster, wheel set (Wheel Set), primary spring, axle box, bearing, brake shoes, braking equipment and supporting equipment. One of the supporting components of a bogie is a bolster. Bolster is a supporting medium used to connect the bogie frame to the carriage chassis. Where this bogie has 1 pivot which is useful for setting the rotation point when the train makes a turn. Plus, the pivot is useful for connecting the chassis body to the bogie frame. Therefore, this scientific writing discusses the process of making Bolster UGL 60 FT on Container Flat Top (CFT) Wagon type goods trains. There are several stages in making the UGL 60 FT bolster which will be explained in this report, starting from the production process to the assembly process for this UGL 60 FT bolster.

RESEARCH METHODOLOGY

The following is a flowchart for making UGL 60 FT bolsters for a Container Flat Top (CFT) Wagon type goods train at PT. Railway Industry.

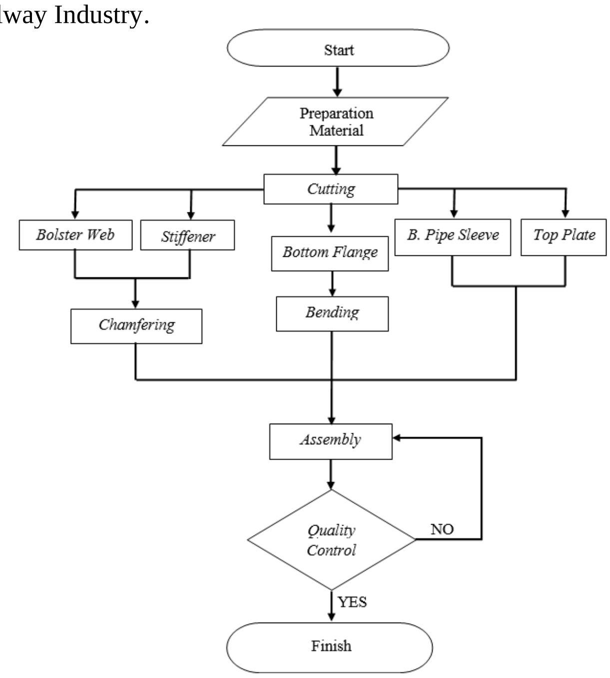

Figure 1. Flowchart Research

Explanation of Bolster Production Process Flowchart

The following are the results and discussion of scientific writing on the Bolster production process at PT. Railway Industry

Material preparation

PT. The Railway Industry (Persero) brings in raw materials from PT. Krakatoa Steel (Persero) but the material is controlled by PT. Railway Industry (Persero) so that the material meets the standards for material design. Making Bolsters requires 3 materials, namely: EN 10025-6 S690Q Steel Plate, EN 10025-2:2004 S355J2 + N Steel Plate and BS EN 10305-1 Steel Tube E235.

RESULT AND DISCUSSION

Material Cutting Process

The material cutting process is carried out with two machines, namely, plasma cutting and bandsaw, the following is an explanation of the cutting process carried out by these machines:

a. Plasma Cutting

The Plasma Cutting machine used is Widspeac which comes from the People's Republic of China (PRC). Plasma cutting machines use LPG as fuel for cutting and are assisted by oxygen gas. The nozzles used vary, there are 2-6 nozzles used in plasma cutting. This machine has the ability to cut steel material with a thickness of between 5 mm – 120 mm and a cutting speed of 50 mm – 750 mm.

Figure 1. Plasma Cutting Machining Process

b. Bandsaw

Banshaw machines are used to cut irregular shapes, and can also be used to produce straight cuts. The cutting process using the Amada H-650HD type bandsaw cutting machine and the scarf saw blade is done manually, therefore the size is given a tolerance so that it is not less than the specified size. The bandsaw itself can cut pipe stems up to 600 mm in diameter.

Figure 8. Banshaw Machine

Part Bolster

After going through the cutting process which produces several single parts which will later be used to make bolsters, before entering the assembly process, these single parts will undergo several machining processes, such as the bending process and the chamfering process. The following is an explanation of the bending and chamfering process for several single part bolsters:

a. Web Bolster

The web bolter that has been cut is then carried out by a chamfering process or the process of cutting corners to form a chamfer using a brander machine which aims to facilitate the assembly process or assembly process using welding. The cutting angle on the bolster web is 30°. The following image 9 shows a brander machine used for the chamfering process.

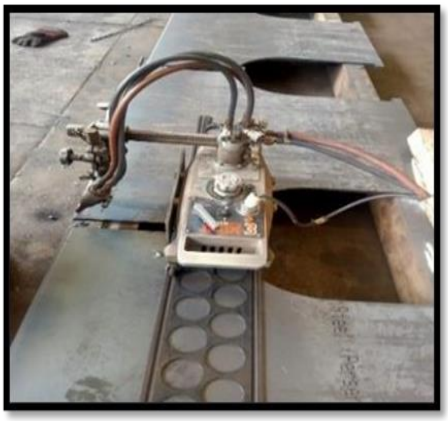

Figure 3. Brander machine

b. Stiffener

The stiffener that has been cut is then subjected to a chamfering or corner cutting process using a brander machine. The cutting angle that is cut is 45°. The following is picture 10. 2D design of the stiffener.

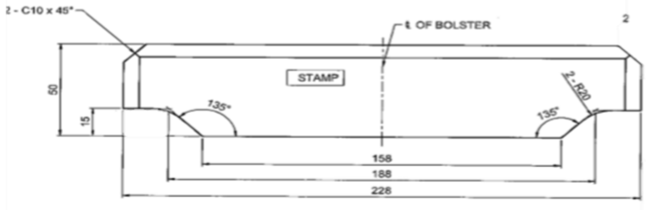

Figure 10. 2D design of the stiffener

c. Bottom Flange

After the cutting process is carried out, the bottom flange is taken to the bending process. The bending process is a plastic deformation process of metal, which can experience changes in surface area with the help of piston and mold pressure. The machine used at PT. Industri Kereta Api uses a Nantong Donghai Machine Tool (Press Brake) with a Double Action type with a maximum strength of up to 50 tons or can bend plates with a plate thickness of up to 60 mm. Here's a picture 11. is the bending process of the bottom flange.

Figure 11. Bending process on bottom flange

To determine the pressing force on the plate, operators usually use a formula:

$$P_b = \frac{\sigma\sigma_0 L h^2}{2(R + \frac{h}{2})} tan \frac{\alpha}{2}$$

$$P_b = \frac{690x699,8x25}{2(72,35 + \frac{25}{2})} tan \frac{144,7}{2} = 5.589 \text{ N } = 5,69 \text{ Ton}$$

In the above calculation, the value 690 is the yield stress of the S690Q material, 699.8 is the length of the bending plate at the bottom flange of the bolster, 25 is the value of the thickness of the S690Q plate to be bent and 72.35 is the radius of the part being bent and 144 .7 is the bending angle of the part to be bent. The result of the pressing force obtained from the calculation results is 5.69 tons.

Assembly

Assembly is a process of mechanically connecting or combining two or more components into a unit. The bolster assembly process is carried out using a welding assembly type and a tool in the form of a JIG. In welding, the machine used is a 350 ampere GMAW welding machine and uses AWS ER 705-6 (A5.18) welding wire type electrodes with an electrode diameter of 1.2 mm, and AR 82% gas + 18% CO2. The assembly process in making Bolsters is divided into several steps as follows:

a. Settings In JIG
The first step in assembly is installing the single part bolster with the help of a JIG, JIG compartment and a wrench to lock it so that the single part does not move when welding. In this process, the bottom flange is placed on the Jig table, then 2 bolster webs and the brake pipe sleeve are attached with the help of the jig compartment.

b. Tack Welding and Deep Welding
After the single part is installed on the JIG table, spot welding (tack welding) is carried out to hold two or more single part bolsters together during the welding process. Tack welding is carried out on single part connections. After completing spot welding (tack welding) then proceed with internal welding. The internal welding process is carried out on single part joints in accordance with the internal welding instructions and welding procedures which refer to the Welding Procedure Specification (WPS).

Figure 12. Tack Welding and Welding Process in Bolsters

c. Full Welding (Full Welding)
After tack welding is carried out, full welding is then carried out. In full welding, the top plate is connected and welding is carried out thoroughly by referring to the welding map and Welding Procedure Specification (WPS).

Figure 13 Full Welding Results

Quality Control

After the welding process is complete, the bolster is taken using a crane to the Quality Control area for the checking/testing process after the welding process is carried out. There are 2 types of tests for bolsters, namely visual test (VT) and magnetic test (MT). The following is an explanation of the tests carried out by quality control:

a. The Visual Test process is carried out by the Quality Control (QC) operator. The visual test process aims to ensure that welding defects do not occur in this welding part. Defects usually occur during the welding process, the defects found are small cracks or spatter, spatter is also called welding splashes/hot metal that sticks to the base material. If there is too much, the spatter area will experience cracks or cracks. Small cracks or spatter can be repaired using grinding or brushing (wire brush), but if the crack is severe enough, the welding process is carried out again.

b. Magnetic testing is carried out to check for discontinuities in the material that has undergone the welding process. This magnetic test uses a yoke tool and is assisted by magnetic particle oil fluid. In figure 3.26 is the magnetic test (MT) carried out by quality control.

Figure 14. Magnetic Test (MT) Testing

Finishing

At the end of the series of goods train bolster production processes, it will be sent to the assembly division for the assembly process to be carried out on the freight train bogie frame. The following is a UGL 60 FT Container Flat Top (CFT) Wagon type bolster that has passed Quality Control (QC).

Figure 15. Bolster UGL 60 FT

CONCLUSION

From the discussion of scientific writing that has been explained, conclusions can be drawn according to the topic in this scientific writing, the process of making Bolsters at PT. Railway Industry. These conclusions include:

1. In the process of making this Bolster, several materials are used, namely S690Q, S355 J2 + N and E235 with various plate thicknesses used according to the needs of the single part of the bolster. S690Q is low carbon steel with a carbon content of 0.12 - 0.21% material condition in plate form. S355 J2+N is low carbon steel with a carbon content of 0.22% material condition in plate form. And E235 is a type of low carbon steel with a Max carbon content of 0.17%, material condition in the form of a tube pipe. In S690Q steel, S355 J2 + N and E235 are widely used in bolster materials because they are able to withstand heavy loads.
2. The process of making the bolster first prepares the material S690Q, S355 J2+N and E235. The bolster production process is carried out using 5 different machines,

namely, Plasma Cutting, Press Brake (NANGTONG DONGHAI MACHINE TOOL), Brander machine, Bandshaw machine, and welding machine. In the cutting process, the workpiece is cut using a Plasma Cutting and Bandshaw machine, then enters the Bending process, namely the process of bending the workpiece, then the Chamfering process is carried out, namely the machining process to cut corners to form a chamfer on the workpiece.

3. Next, we enter the Assembly process, namely the process of joining two or more pieces of metal of the same type as the part joining process itself using the help of a JIG and jig compartment. After the single part is installed on the JIG table, the welding process is carried out using a 350 Ampere GMAW welding machine and using AWS ER 705-6 (A5.18) 1.2 mm welding wire type electrodes, and the help of AR 82% gas + 18% CO2. Welding in making Bolsters is divided into several processes, namely setting on jig, deep welding, tack welding and full welding. Before the bolster is assembled, the bolster is taken to the quality control area to check the workpiece determine whether it is appropriate or not by Quality Control (QC) which includes visual tests and magnetic tests. If the workpiece is said to be suitable, it will be taken to the assembly process in the assembly division, if not, the workpiece will be repaired or repaired again in the assembly room.

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