World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:9, No:11, 2015

Analysis of Control by Flattening of the Welded Tubes

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Abstract**—**In this approach, we have tried to describe the flattening of welded tubes, and its experimental application. The test is carried out at the (National product processing company dishes and tubes production). Usually, the final products (tubes) undergo a series of non-destructive inspection online and offline welding, and obviously destructive mechanical testing (bending, flattening, flaring, etc.). For this and for the purpose of implementing the flattening test, which applies to the processing of round tubes in other forms, it took four sections of welded tubes draft (before stretching hot) and welded tubes finished (after drawing hot and annealing), it was also noted the report 'health' flattened tubes must not show or crack or tear. The test is considered poor if it reveals a lack of ductility of the metal.

Keywords**—**Flattening, destructive testing, tube drafts, finished tube, Castem 2001.

I. INTRODUCTION

MANY steels for general purposes, including plates and profiles, are implemented by welding. Today, an estimated 60 to 80% of the world's steel is used for making welded products. The welding is used in the manufacture and assembly of metal from microelectronics to the manufacture of large hydraulic press corps. We can now weld elements thickness of 0.1 mm to 1000 mm or more, soda on almost all metals and alloys used in modern technology. The welding processes and reloading are widely used for the rehabilitation of parts and assemblies worn or damaged. The definition of the weldability, of these steels, is complex because it is a qualitative property assessed by using different criteria depending on the achievements contemplated; It involves many parameters, the steel being only one of them. It is therefore not subject to specific safeguards, but producers make available to users the information necessary for the successful completion of welding, assembly integrity, integrity essential to avoid any risk of ruin by cracking and breaking from defects [1] .

The current development of welding processes is focused towards perfecting the techniques of use (procedures, metallurgy, and equipment), to the introduction of industrial robots and programming, to the application of new energy sources (Laser) [2]. One of the main applications of welding is the manufacture of pipes, and other products closed steel, aluminum or copper by a process fully meeting requirements industrial welding tubes induction high frequency (HF) [3]. In addition, the familiarity of the material used is essential for the achievement of a satisfactory structure, which gives a guarantee, design-sizing.The adaptability and reliability of the mechanical properties of the steel used (E24-2) goes through a series of quality control, developing a series of tests to control destructive nature (CD) which apply mainly to test pieces and sections of the tubes comprising mainly: traction, hardness, impact strength, bending, flattening, flaring, and so on. executed in the draft (not laminate welded tube) and finished product (tube hot rolled and reclaimed by annealing for Standardization). The experimental study of the test flattening is made to the ENTTPP of Tébessa; the results are stored in Tables I-IV.

II. MATERIAL AND PROCEDURE

The material used for welding of steel tubes is E24-2 construction, the chemical composition of which is shown in Table I [4]. According to the chemical composition given by the Table I, steel regarded (E24) belongs to the group of steels with low carbon percentage (mild steel) and dual constituents (ferrite and pyrite), with a dominance of ferrite (89%), which is why it is also said ferritic steel.

TABLE I
CHEMICAL COMPOSITION OF THE STEEL S235JR [5]

C	P	S	N
0,17	0,045	0,045	0,008

TABLE II
VALUES STANDARDIZED CALCULATION OF THE MAIN PROPERTIES OF STEEL S235JR [6]

characteristics	Symbols	Values
Modulus of elasticity (to Young)	E	210 KN/mm^2
Module sliding	G	81 KN/mm^2
Lateral contraction coefficient (Poisson)	ν	0,3
Coefficient of thermal expansion	α_T	10^{-5}/°C
Charge density (density)	γ	78,5KN/m^3

It is imperative that service technician's quality control, specialists design and assembly of metal must be aware of the metallurgical and mechanical properties of the material was welded and checked. In our case the (E24) is a steel construction in frequent use, its mechanical properties are summarized in Table IV.

The French standard (NF EN 10233 February 1994, A 49-853) specifies a method for determining the ability to plastically deform by flattening of metal tubes of circular cross section; it may also reveal defects in the tubes. The standard is applicable to tube outside diameter less than or equal to 600 mm and thickness not exceeding 15% of the outer diameter. The flattening between the trays, a host of a specimen

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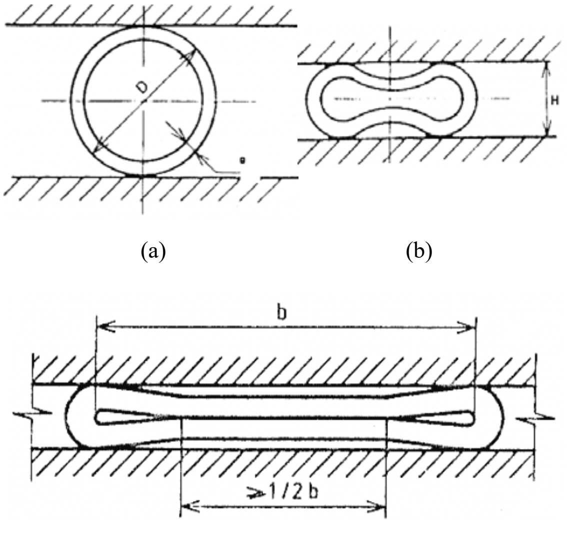
collected at the end of a tube or cut from a tube in the direction perpendicular to the longitudinal axis of the tube until the distance between the shelves, as measured under load in the direction of the flattening, reaches the value specified in the standard product in question (as shown in Figs. 1 (a) and (b)). If flattening told bloc, the inner surfaces of the specimen must come into contact with each other on at least half the width of the specimen b flat (Fig. 1 (c)) [7].



(a) (b)

(c)

Fig. 1 Principle of the test flattening

TABLE III
SYMBOLS AND DESIGNATIONS

Symbols	Description	Unit
D	Outer diameter tube	mm
T	Wall Thickness tube	mm
b	Inside width of the specimen flattened	mm
L_e	The length of the specimen	mm
H	Distance between plateaus measured under load	mm

The length of the test should not be less than 10 mm, and must not exceed 100 mm. The test specimen shall be considered adequate if we do not detect any cracks visible without magnification means. A slight cracking of banks should not be seen as a cause of discarded [8]. The flattening test is performed in accordance with the standard NF EN 10233, at one end of the tube or on a wall of a minimum length of 30 mm levied at one end of the tube. The flattening is conducted until the distance between H plateau, as measured under load, reaches the value set by the formula (1):

$$H = \left(\frac{1+k}{k+\frac{T}{D}} \right) .T \tag{1}$$

The value of K was 0.09. Value lower limit of H equal to (4T) [8]. The flattened specimen shall not crack or tear. The test is considered poor if it reveals a lack of ductility of the metal [9]. The tubes are banding drafts (before annealing) rolled by the roll forming and welded, while the tubes are tubes finished (after annealing) drafts operation followed by drawing hot for the dressed shape then annealed in the air (as shown in Fig. 2). The steel pipe is offered to the state stretched and the state annealing, in a variety of lengths, diameters, and thicknesses to meet a variety of needs.

The usage of steel pipe is today increasingly numerous. It is used both for making big varieties in size and quality, Fig. 3 illustrates the practical method to get different thicknesses and diameters is depicted as follows:

Rolled Coils → then welded tube induction → obtaining tube Roughing → hot links (Operation Drawing) and annealing in the air (relaxation) → finished tube (in shape)

TABLE IV
TESTING FLATTENING

Test	Dimensions (mm)			Flattening		
	N°	D_{ext}	T	H_{cal} (mm)	H_{mes}(mm)	H_{min}(mm)
Types Tube Roughing	1	118,5	3,10	29,10	28,70	12,4
	2	94,0	3,10	27,69	26,60	12,4
	3	80,3	3,10	26.39	25,00	12,4
	4	70,7	3,10	25,24	23,50	12,4
Rough	1	48,3	2,70	20,17	20,00	10,8
	2	48,3	2,20	17,69	20,00	8,8
	3	21,3	2,00	11,85	10,00	8
Section of type	4	33,5	2,40	16,35	16,00	9,6

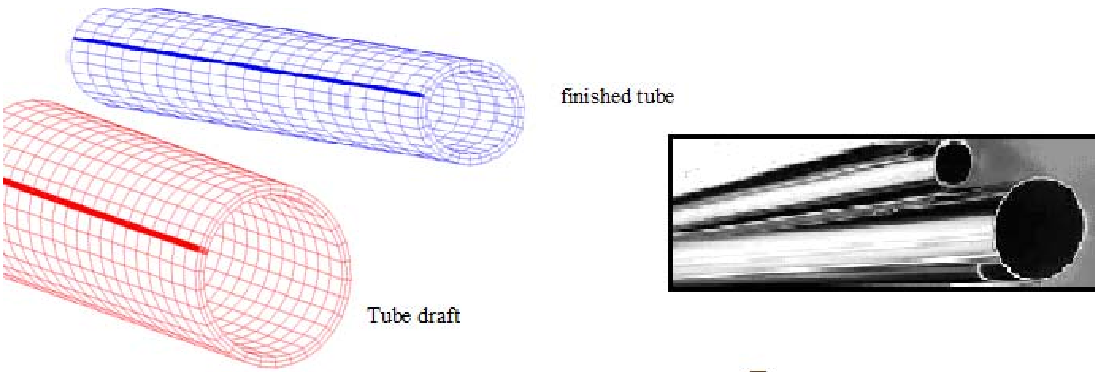


Fig. 2 Tube draft (before annealing) and finished tube (after annealing)

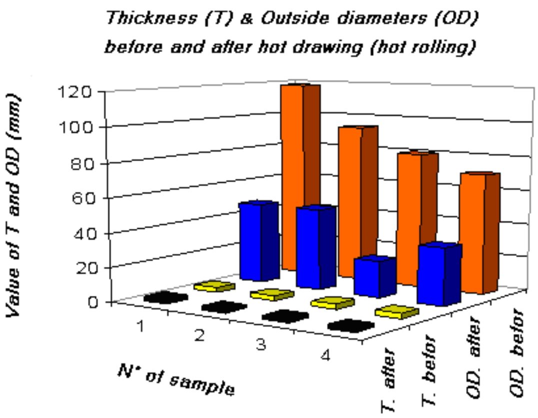


Fig. 3 Comparison of thickness and outside diameter before and after rolling

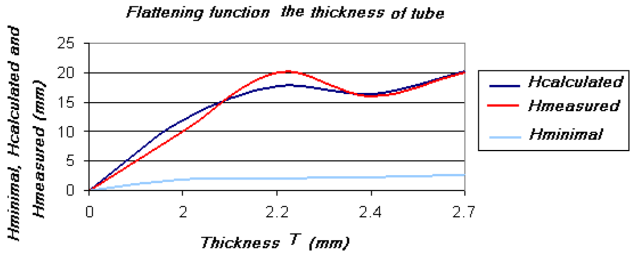


Fig. 4 Comparison of flattening minimum, calculated and measured in office Thicknesses after rolling and annealing

H_{calcul}, $H_{measures,}$ and minimum tubes moves clearly based on increases in thickness (Fig. 4) for both types of samples (blanks and finished), and flattening measured tubes (drafts and finished) important as the flattening calculated in most of the time. Figs. 5 and 6 show the flattening minimum, measured and calculated for two types of samples, respectively (tubes and finished drafts), the differences in values due to the large thickness and outside diameter in the case of tubes drafts and average values for small thickness and outside diameter. $H_{calculated}$, $H_{measured}$ and minimum tubes moves clearly based on increases in average outside diameters (as shown in Fig. 7) and large outside diameters (as shown in Fig. 8) for both types of samples (blanks and finished), and flattening measured tubes (drafts and finished) important as the flattening calculated in most of the time.

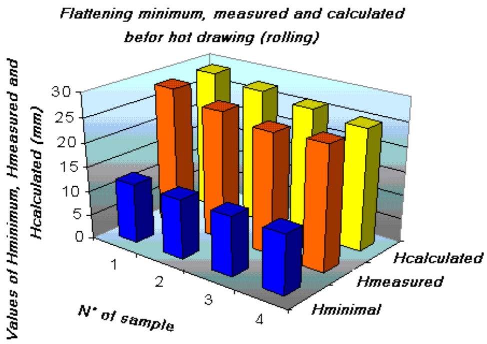


Fig. 5 Flattening minimal measured and calculated before and after rolling

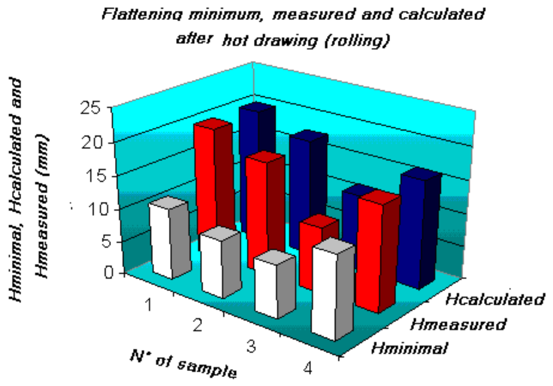


Fig. 6 Flattening minimal, measured and calculated before and after rolling

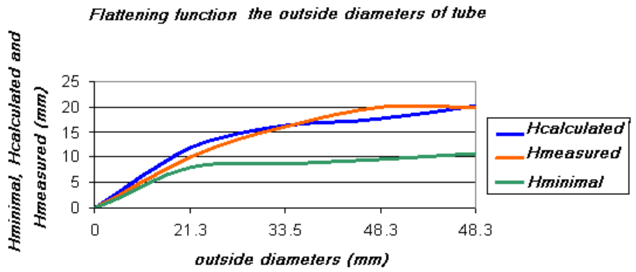


Fig. 7 Comparison of flattening minimum, calculated and measured in office the outside diameter before rolling and annealing

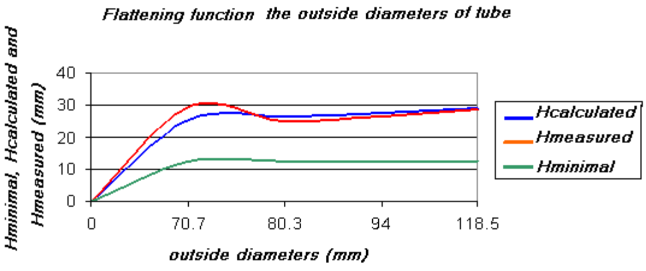


Fig. 8 Comparison of the calculated and measured flattening in office the outside diameter

III. Material and Procedure

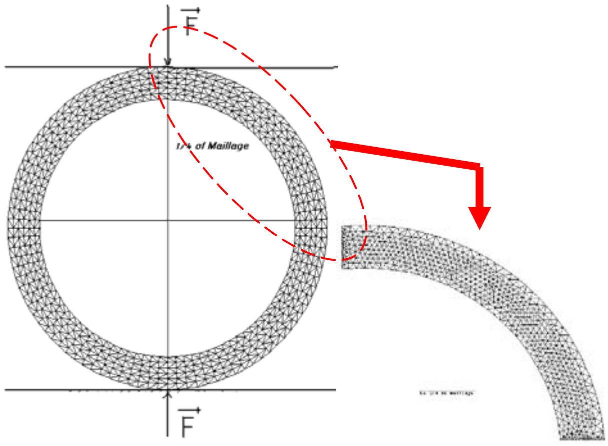


Fig. 9 A quarter section of the pipe: for reasons of symmetry, only ¼ of the section of pipe is considered

During the execution of the load and in a short span of time, the tube begins to deform providing new structures, such as the oval-shaped and elliptical, it continues to achieve its larger deformations where the destruction and damage the structure and arcs of the circle begins to be parallel. The flattening of an elliptical tube section presents three distinct phases. Firstly the tube ova led by canceling the curve on the short axis, then after reversing concavity, the opposing walls, which were substantially parallel move closer to touch in the center finally, and mark the start of the second phase. During this new phase, the curvature at the point of contact (center O) gradually becomes zero; a segment of contact can be developed in the last phase.

IV. CONCLUSION

In the area of production tubing research is regularly conducted to gain knowledge innovative, this need arising from the strong competition and rapidly changing technology in order to respond to market demands and provide satisfactorily and continuing a guarantee the product quality and design.

The flattening test is a method to flatten a sample tube between parallel plates (compression) with the weld at 90° from the direction of the applied force until the opposite walls of the tube are touching. It applies to the processing of round tubes in other forms.

The experiment is done at the ENTTPP of Tébessa given to satisfactory results without disclosing defects on the four tube samples (blanks and finished).

The digital followed by finite element (EF), we are allowed to see the deformation near samples at different amplitudes. As recorded in the flattening graphics changes based on external diameters and thicknesses, and the flattening calculated tubes (drafts and finished) are important as the flattening measured.

For quality control testing is considered a procedure to determine the relative ductility of metals to form (usually pipes), without cracking (tear) or default (crack) The test is considered poor if it reveals a lack of ductility of the metal.

In conclusion, test flattening is essential and highly recommended for the control of the quality of welded tubes in order to ensure a saint. Destructive testing is a valuable tool when used in support of defect prevention.

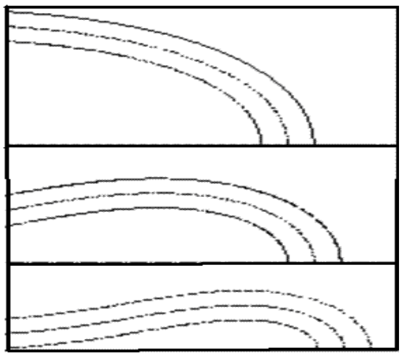


Fig. 10 ¼ tube considered for the simulation

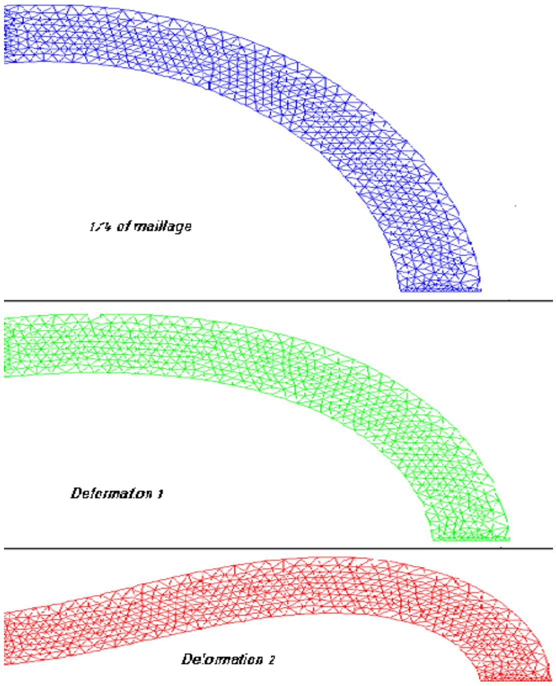


Fig. 11 Numerical simulation of tube ¼ 2D and registration deformations

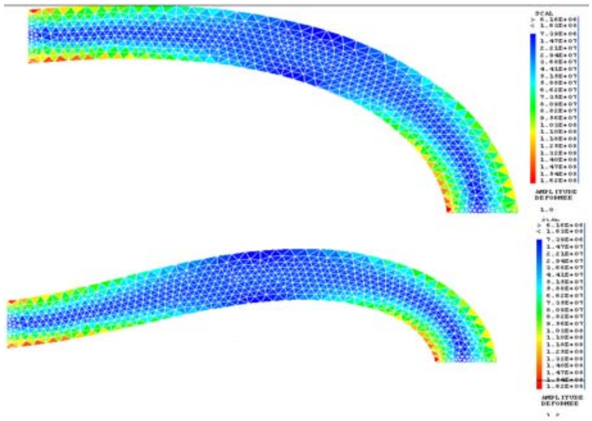


Fig. 12 Visualization of the constraints of Von Mises distorted

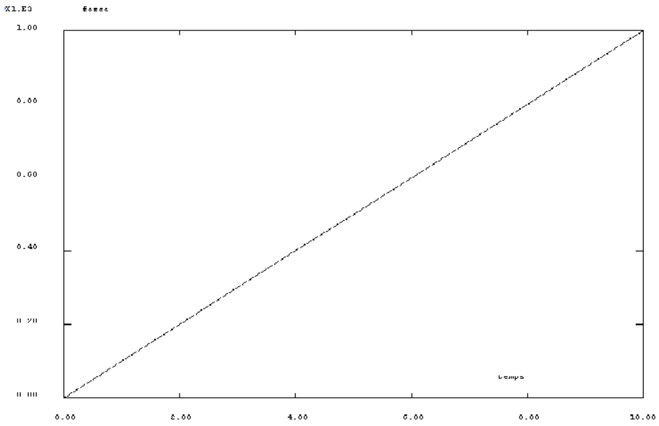


Fig. 13 Evolution of the load as a function of time

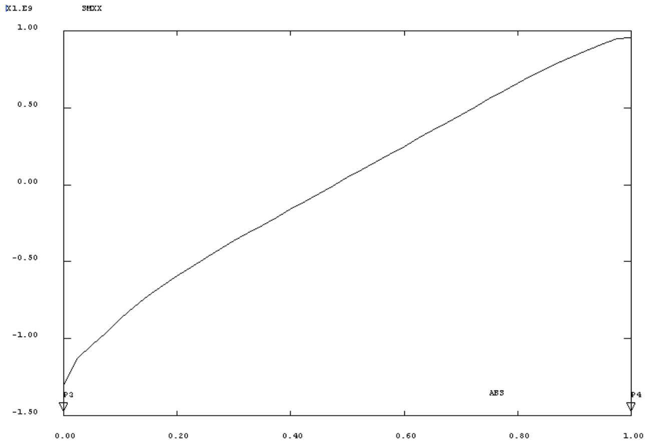


Fig. 14 Variation of the main (stress) MXX

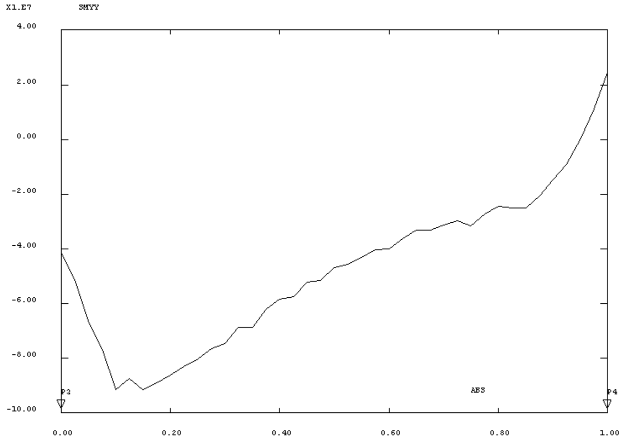


Fig. 15 Variation of the main (stress) MYY

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