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AN APPARATUS BASED APPROACH FOR COMPREHENSIVE MEASUREMENT OF BRIGHT BAR PARAMETERS

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Abstract – *For heavy engineering machinery and in Automobile Sector, the **Bright Bar** is the most important and popular product to achieve the various applications. During the production process of Bright Bars, the production process can be optimized by reducing the Production time and it can be achieved by minimizing the time required for Inspection & Testing, by using **"An Apparatus Based Approach for Comprehensive Measurement of Bright Bar Parameters".** Traditionally, the measurement of Dimensional & Non-dimensional Parameters is carried out by different instruments which increases fatigue of operator and the Inspection time and due to this the Production Time increases. So, to optimize the production time, the "Bright Bar Testing Machine" is more useful in the industry to facilitate the measurement of parameters and to increase the productivity. An apparatus developed for comprehensive measurement of Bright Bar Parameters is useful for checking the various Dimensional and Non-dimensional parameters such as - Overall Diameter , Circularity Error, Straightness Error, Maximum Amount of Bending and the number of Surface Cracks on the Bright Bar. The details regarding Experimental Measurement and it's calibration is carried out to ensure the accuracy and minimum error.*

Key Words: Overall Diameter, Circularity Error, Straightness Error, Amount of Bending, Number of Surface Cracks.

1.INTRODUCTION

In today's world, quality control or inspection is very essential to assure the compliance of product with respect to the product drawings, product specifications, material standards which are necessary so as to avoid the errors and defects in the final product. In every factory, the quality control programs are applied with inspection and testing of final products so as to ensure the quality level as per predetermined standards of the product.

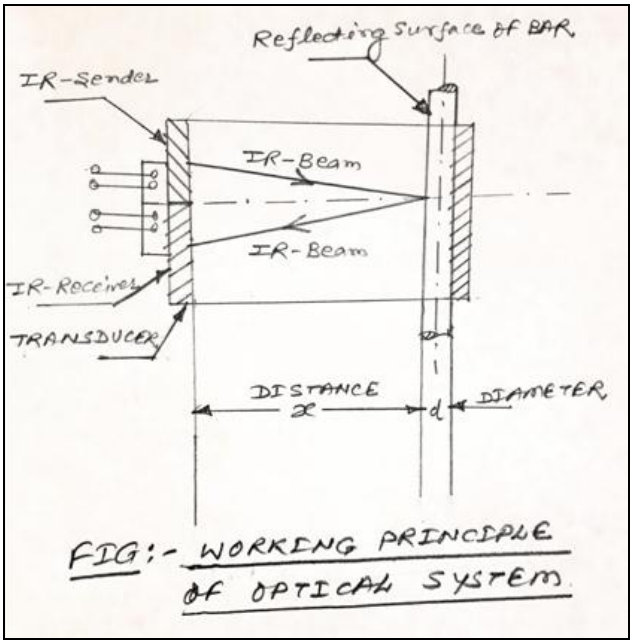
As per survey in the "Bright Bar Manufacturing Industries", it is found that, in most of the industries the Bright Bars are checked by manual methods for the measurement of Overall Diameter, Circularity Error, Amount of Bending, etc and this requires more time for the measurement process and so, to facilitate the Inspection and Testing of Bright Bars during and after the Production Process, there is necessity to use the advanced **Bright Bar Testing Machine**. So, such a machine can be helpful for the measurement of various parameters of Bright Bar in a single unit.

2. Design features of Bright Bar Testing Machine

2.1 The **"Bright Bar Testing Machine"** is designed on the model basis for the checking of various parameters such as – Overall Diameter of Bar, Circularity Error, Straightness Error, Maximum Amount of Bending and Number of Surface Cracks.

Here, for checking the Overall Diameter of Bright Bar, the **Optical System** having IR-beam with Distance Measuring Sensor Unit GP2Y0A02YK0F is used. For the measurement of Circularity Error & Straightness Error, the **"Dial Indicator with Magnetic Stand"** is used at the left end of machine. Also, for the measurement of Amount of Bending of Bright Bar, another set of "Dial Indicator with Magnetic Stand" is used centrally on the machine. Also, for the checking of Surface Cracks on the Bright Bar, the UV-lamp Unit is used at another end of machine. The **Foundation Frame** completely supports the Bright Bar which is being rotated and moved over the Semi-circular Grooved Pulleys during testing.

2.2 Working Principle of Optical System for Overall Diameter Measurement



As the IR – Beam from Sender Probe is emitted, it is reflected by the Reflecting Surface of Bar and it comes onto the Receiver Probe. Thereby, the Time Elapsed (t) between Sender and Receiver Probe is analyzed by the circuit, which depends upon the Distance (x). As the diameter of Bar (d) changes, the distance (x) changes and thereby the Display Device gives the reading of Diameter of bar (d).

2.3 Three-Dimensional View of Machine

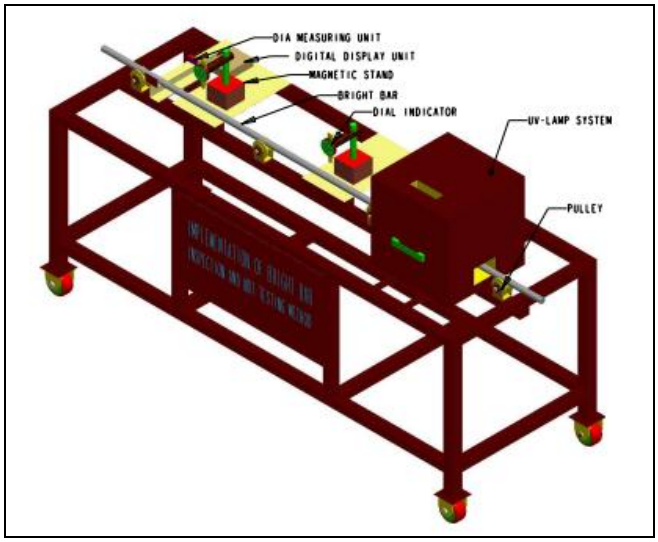


Fig -1: 3D-View of Machine

Fig. 2: Photograph of Demonstration of Bright Bar Testing Machine at M/S. Vinayaka Bright Steels Pvt. Ltd., C-67, MIDC Hingna Road, Nagpur.

2.4 Testing Results of Bright Bar

2.4.1 Testing of Overall Diameter of Bright Bar

Here, the Overall Diameter of Bright Bar is checked by Non-contact type method by using the Optical System and the Diameter of Bright Bar is measured as 18.75 mm as against reading 18.81 mm by using Digital Vernier Caliper.

2.4.2 Testing of Circularity Error of Bright Bar

The various points along the Bright Bar are marked at a distance of 375 mm from End (A) to End (B) of Bright Bar and then at a particular section, the Bright Bar is rotated through one complete revolution under the Set-up of Dial Indicator and the Ymin & Ymax readings are noted and thereby the Circularity Error at a particular section is calculated. The Bright Bar is moved under the Set-up of Dial Indicator through 375 mm and the various readings of Dial Indicator are taken and the Readings of Diameter at various Cross-Sections of Bar are taken by Digital Vernier Caliper and thereby the Overall Circularity Error is calculated as under –

Sr. No.	Location of Section from End (A) mm	Readings of Dial Indicator for one complete revolution of bar		ΔY = (Ymax - Ymin)	C.E. = ΔY / Rm = ΔY / 9.405
		Ymin (mm)	Ymax (mm)		
1	375	0.677	0.8	0.123	0.013
2	750	0.317	0.822	0.505	0.054
3	1125	0.242	0.786	0.544	0.058
4	1500	0.352	0.492	0.14	0.015
5	1875	0.142	0.345	0.203	0.022
Average Value of C.E =					**0.032**

Readings of Diameter at various Cross-Sections of bar, by using Digital Vernier Caliper					
D1 = 18.75 mm	D2 = 18.74 mm	D3 = 18.96 mm	D4 = 18.79 mm	Dav = 18.81 mm	Rm = 9.405 mm

2.4.3 Testing of Straightness Error of Bright Bar

The various points along the Bright Bar are marked at a distance of 100 mm from End (A) to End (B) and the Bright Bar is traversed under the Set-up of Dial Indicator to reach at a particular section and the reading of Dial Indicator is noted. The Bright Bar is moved under the Set-up of Dial Indicator through 100 mm and the various readings of Dial Indicator are taken and thereby the Overall Straightness Error is calculated as under –

Point Sr. No.	**Reading of Dial Indicator (Y) (mm)**	**Distance along axis from end (A) (mm)**
P1	0.685	375
P2	0.763	475
P3	0.694	575
P4	0.562	675
P5	0.319	775
P6	0.385	875
P7	0.159	975
P8	0.206	1075
P9	0.277	1175
P10	0.486	1275
P11	0.496	1375
P12	0.417	1475
P13	0.39	1575
P14	0.241	1675
P15	0.211	1775
Ymax =	**0.763**	**L = (1775 - 375) = 1400**
Ymin =	**0.159**	
Straightness Error =		**(Ymax - Ymin)/L**
Straightness Error =		**0.000431429 mm/mm**
Straightness Error =		**431.429 µm/m**

2.4.4 Testing of Amount of Bending of Bright Bar

Firstly the bar is located on the supports (i.e. Pulleys) and the Bar is rotated completely and the Minimum Reading of Dial Indicator (Ymin) is obtained and thereby Half-Revolution is applied to the Bar and then the Maximum Reading of Dial Indicator (Ymax) is noted and the calculations are carried out as under -

Δ Y = Change in Dial Indicator Readings for Dial Indicator2, for Half revolution of Bar = [Ymax – Ymin] = [0.675 – 0.255] mm = 0.42 mm ;

L = Distance between Support Pulley No.1 & Support Pulley No.2 = Effective length of Bar under test = 711.2 mm.

Therefore,

Amount of Bending = (Δ Y / 2) / L = [0.21/711.2]mm / mm = 0.00029527 mm/mm = 295.275 µm/m.

2.4.4 Testing of No. of Surface Cracks on Bright Bar

The number of Surface Cracks along the periphery of Bright Bar are checked by imparting the complete revolution to the Bar at a particular section from end (A) .

Sr. No.	**Distance of point from end (A) (mm)**	**No. of Cracks found along the periphery of bar**
1	100	2
2	200	3
3	300	6
4	400	4
5	500	3
6	600	2
7	700	3
8	800	4
9	900	4
10	1000	7
11	1100	5
12	1200	6
13	1300	4
14	1400	3
15	1500	2

3. Results and Discussion

The reading for Overall Diameter of Bright Bar by using Non-contact type Optical System is found out as 18.75 mm as against 18.81 mm by Digital Vernier Caliper.

The Overall Circularity Error of Bright Bar by using Set-up of Analog Type Dial Indicator is found out as 0.032 mm/mm & the Overall Straightness Error of Bright Bar is found out as 431.429 µm/m and the Amount of Bending of Bright Bar at the centre by using Set-up of Analog Type Dial Indicator is found out as 295.275 µm/m. The overall length of Bright Bar under test is 1800 mm.

For the testing of long Bright Bars, the Foundation Frame of machine should be of larger size to accommodate the Bar completely. Also, to utilize the same machine for various Bars of different Diameters, the use of V-pulleys will be more advantageous. Also, for more accurate quickly measurement of Overall Diameter of Bar, the Optical Micrometer can be applied along with Servo-motor Controlled Rotary Chuck to rotate the Bar and another Servo-motor Controlled Bar Traversing System for the quickly measurement of Circularity Error and Straightness Error.

4. CONCLUSIONS

In this paper, the method is proposed for Bright Bar Inspection and Testing for the measurement of Overall Diameter of Bright Bar by using Non-contact type Optical System and the measurement of Circularity Error, Straightness Error and Amount of Bending of Bar by using Dial Indicator of Least Count 0.001 mm with a set-up of Magnetic Stand and the Number of Surface Cracks are checked by using UV-lamp System.

This Bright Bar Testing Machine facilitates the measurement of various parameters of Bright Bar efficiently in a single unit. The apparatus is well-calibrated and the results are validated successfully.

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