International Journal of Engineering Research and Development
eISSN : 2278-067X, pISSN : 2278-800X, www.ijerd.com
Volume 4, Issue 8 (November 2012), PP. 37-41

Fracture Split Connecting Rod for Automotive Engines

Mr. Dhole Vasant J. [1], Prof. R. R. Kharde[2], Prof. U. N. Gujar[3]
[1]*Student-ME(Mechanical), PREC, Loni, Dist – Ahmadnagar, Maharashtra (India)*
[2]*Head of Mechanical Engineering Department, PREC, Loni, Dist – Ahmadnagar, Maharashtra (India)*
[3]*Asst. Professor(Mechanical), PREC, Loni, Dist – Ahmadnagar, Maharashtra (India)*

Abstract:—Though US and European countries are using the fracture spilt connecting rods, fracture spilt connecting rod is rarely used for application of commercial vehicles in India. Current Connecting rods were used widely with dowel pin type or serration type. The fracture split method used for connecting rod is attracting attention as a mechanical method that can reduce production cost by decreasing the manufacturing processes. The Conventional micro alloyed steel can not be used for the fracture because of higher ductility. In this method powder metals and forged steel (C70S6) are used. These materials are superior in the fracture surface because of lower ductility. This gives the dimensional stability in order to meet the fitment of connecting rod.
The material C70S6 generally used because of the lower ductility, higher mechanical property and better machinabilty. This existing material used for the connecting rod developed by Indian steel mills. The validation took place at two levels, one is at material level and component level. This paper includes testing details for the same.
Keywords:—Connecting Rod, Fracture split, CONROD, Engine, C70S6

I. INTRODUCTION

New development of engine starts with designing 5C component like con rod, cylinder block and cam shaft etc. The design requirements are derived from the expected performance of the engine in the field. While deciding all these things the cost of the component also plays important role, while satisfying the expectation of customer in terms of cost. In order to achieve cost and quality in the best manner, C70S6 fracture spilt con rod was studied and subsequently introduced in the new generation engine. These engines will have maximum peak firing pressure up to 210 bar. Material needs to develop and validate for the fracture spilt application. It is necessity to study the material property as well as the component level validation for the application. Actual component validation also followed with the peak firing pressure load and inertia load in the same. The component material C70S6 is further studied for the mechanical property and metallurgical analysis.

Firstly the material forging stock is validated for the Rotating bending fatigue strength as well as the push pull fatigue with the load control system. C70S6 Material has the property of brittle fracture with minimum plastic deformation; this increases the conformability of material for fracture splitting. The Con rod is double thermal shocked while forging and control cooled in order to achieve mechanical property. This exercise of developing fracture spilt con rod, further more gives us the broader picture of application and intricate material details for the reason to being C70S6 as a fracture spiltable material. The material and component needs inspection in between at different stages of manufacturing. The C70S6 material strength is nearly equivalent to micro alloyed steel with higher machinability.

The fracture splitting method used with connecting rod (C/rod) is attracting attention as a mechanical method that can reduce production cost by decreasing the manufacturing process. In this method, powder metals and forged steel (C70S6) are generally used. These materials are superior in fracture splitting properties, but inferior in fatigue strength and machinability. Therefore, the authors developed microalloyed steel for C/rod which has high fatigue strength and machinability. Detailed process is given in fig. 1.

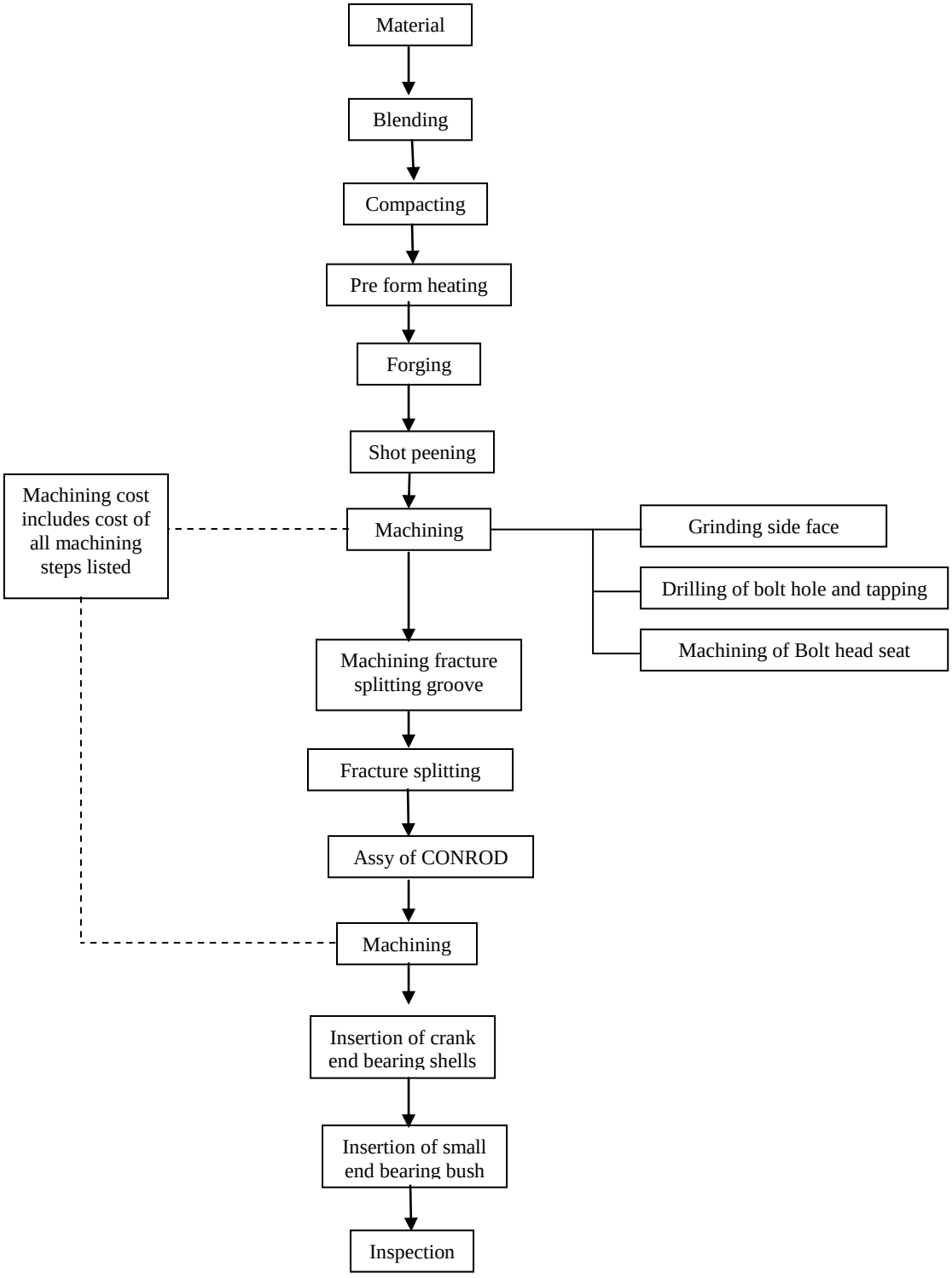


Fig 1 *Powder Forged fracture split process for Connecting Rod*

II. DESIGN ANALYSIS AND CRITICAL POINTS FOR CONNECTING RODS

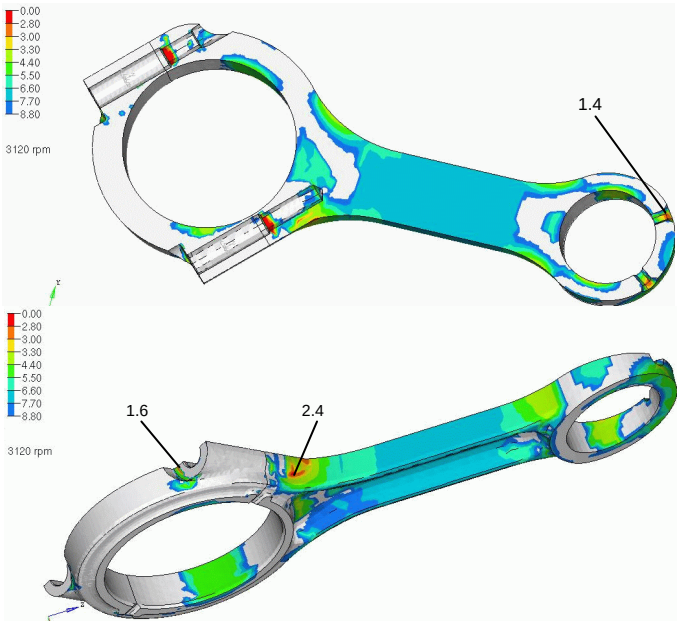


***FIG.2** Safety factor at 3120 RPM 1.4*

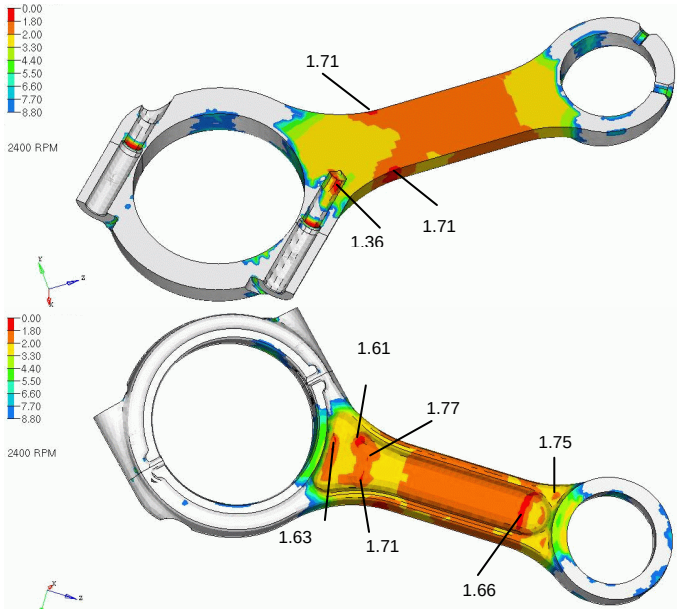


***FIG. 3** Safety factor at 2400 RPM 1.8*

CAE analysis of powder forged connecting rod is done. Above diagrams shows the different safety factors considers for the con rod design. These details further validated for engine performance and component level validation.

III. MATERIAL AND PROPERTY DETAILS FOR C70S6

In Case of C70S6 Material chemical composition play s important role in the case of fracture splitting. The percentage of Sulphur and sulphide morphology also important to have intact fracture surface. This helps fracture surface with more adhesion between the surface particles. The following table will give us the comparison between the conventional steel used for the con rod. After the chemical composition and material studied, further cross sections were forged as per con rod section for the further study.

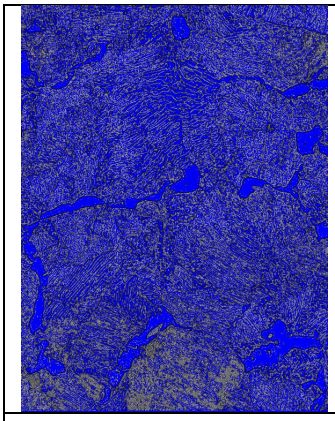
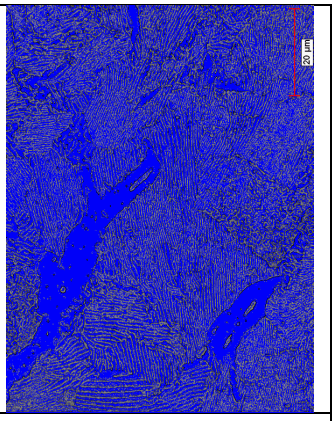
Further the Cross section hot forged and controlled cooled for different cooling rates are studied.

A. Chemical Composition

	C70S6	**40Cr4**
Element	**% Wt.**	**% Wt.**
C	0.68-0.75	0.35-0.40
Si	0.15-0.35	0.10-0.35
Mn	0.50-0.60	0.60-0.90
P	0.045 max	0.035 max
S	0.045	0.020-0.035
Cr	0.1-0.15	1.00-1.20
Mo	0.06 max	0.05max
Ni	0.08 max	--
Va	0.03 – 0.06	--
Al	0.010 max	--
Cu	0.30 max	--
Fe	Bal.	Bal.

B. Microstructure Analysis

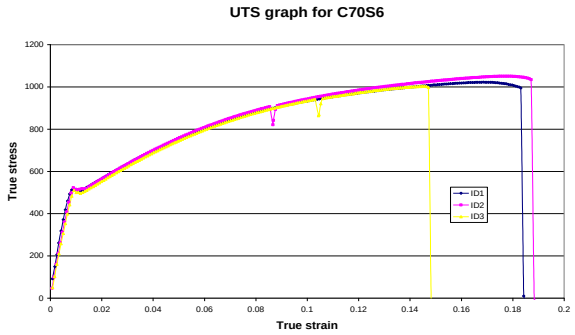
The samples were studied for the metallurgical phase analysis qualitative as well as in quantitative manner. Please find below details analysis for microstructure.

	
At 500X Picral Statistics Field Area: 28059.82µm² Total Area: 28059.82µm² Proeutectoid Ferrite+ ferrite is in pearlite 46.44 Rest Fe_3C	AT 1000X Picral Complete ferrite 56.28 Statistics Field Area: 6840.24µm² Total Area: 6840.24µm²

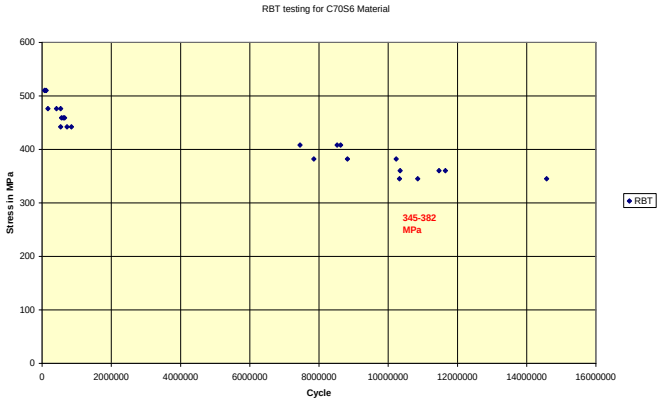
Below are some mechanical properties of C70S6 which are widely known-

Yield strength MPa	550 min
Tensile strength MPa	900 - 1050 min
Fatigue strength MPa	345
% Elongation	10 min
% R.A.	15-30 max
Impact (3mm U Notch)	25 J (Target)

Tensile testing of fracture split connecting rod was conducted which results to below UTS graph,



S-N Curve for C70S6 CONROD is drawn,



The RBT fatigue limit is 370MPa.

IV. CONCLUSIONS

From extensive material testing and mechanical testing of connecting rod it is concluded that,

1. C70S6, high carbon micro-alloyed steel has lower ductility, higher mechanical property and better machinability.
2. Considering static strength, buckling load factor, and fatigue strength, it was found that the fatigue strength of the connecting rod is the most significant and the driving factor in the design and optimization of connecting rod.
3. Unlike the conventional types where the rods and caps are separately forged and machined, this steel split con rod needs no additional rod/cap contact face milling which means a substantial savings in machining cost. Besides, a firm contact between rod and cap improves stiffness and compatibility with other crank-train moving parts - a definite merit in engine performance.

REFERENCES

[1]. Adila Afzal and Ali Fatemi, *Comparative Study of Fatigue Behaviour and Life Predictions of Forged Steel and PM Connecting Rods*, SAE international, 2004-01-1529

[2]. M. Omid, S.S.Mohtasebi, S.A.Mireei and E.Mahmoodi, *Fatigue Analysis of Connecting Rod of U650 Tractor in the Finite Element code ANSYS*, Journal of Applied Sciences:4338-4345, 2008

[3]. James R. Dale, *Connecting rod evaluation*, January 2008.

[4]. Pravardhan S. Shenoy, *Dynamic load analysis and Optimization of connecting Rod*, May 2004