TLW2503
TEST REPORT

CASE DEPTH ANALYSIS OF MPIF MIM-2700 SAMPLE MATERIAL

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INTRODUCTION

The initial requirement of TLW2503 was to determine if the proposed process for heat treatment of the Remington M770 triggers manufactured from MPIF MIM-2700 material will meet the Remington standard case hardness specification of HR15n 88-92 with a minimum effective case depth of 0.008". The underlying reason for the request is to determine if the parts can be heat treated and then the sear interface surface ground in production. The intent is to grind partially through the case, but leave enough case to support the function of the trigger during normal functioning. To this end, four sample revolver hammers were delivered to the Remington R&D technical center for evaluation. The hammers were heat treated by the vendor and are manufactured using MPIF MIM-2700 material.

RESULTS SUMMARY

The four hammers all met the superficial hardness specification of HR15n 88-92 and the minimum effective case depth specification of 0.008", ranging between 0.008" and 0.011" effective case depth.

CONCLUSIONS & RECOMMENDATIONS

While the proposed heat treatment met the minimum case depth and hardness specification stated on the drawings, the proposed process of grinding the sear surface of the parts with this heat treatment specification is not recommended. Two alternatives are recommended if the process of heat treating the triggers followed by grinding the sear interface surface is to be used to manufacture the finished M770 trigger.

1. Change the heat treatment specification to ***HR15n 88-92; 0.015" Min. Eff. Case***. Based on the communicated information, the worst case condition would require grinding approximately 0.005" from the surface of the trigger. An effective case depth of 0.015" would ensure that at least 0.008" of effective case remain after the grind operation. The additional benefit is that the case hardness and minimum depth can be checked by performing a HR15n indent on the ground surface. As long as 0.008" of effective case depth is present, the HR15n reading will be 88 or greater.

2. Change the material and heat treatment to ***MPIF MIM-4605, Oil Quench and Temper, HRc 48 Min.*** This may require at least a dry-cycle evaluation of the fire control. The benefit is that this material will be through hardened and there is no risk of grinding too far into the material. The hardness specification of HRc 48 minimum is effectively the same as the ASTM minimum case hardness requirements. It is expected that the wear of this type of component will be similar to a case hardened part.

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PROCEDURE

The four sample hammers were initially examined per the superficial hardness specification of HR15n 88-92. This evaluation was performed by obtaining three measurements from each of the four test pieces. The machine calibration was validated by performing three hardness measurements on a HR15n 90.2+/-0.7 calibrated test block. The three validation measurements were 90.3, 90.4, and 90.3, verifying that the equipment was within specification.

The four hammer samples were sectioned along the hammer and the removed portion was metallurgically mounted in bakelite. Figure 1 presents an image of one of the hammer samples and the location of the section line and the portion which was prepared for evaluation. These samples were polished to a 0.05μm finish in preparation for micro-hardness testing. The micro-hardness measurements were performed using the Vicker's hardness scale and a 500g load. Indents were taken starting approximately 0.003" from the edge at 0.002" spacing to approximately 0.020" depth, 0.005" spacing to approximately 0.040" depth, and then 0.010" spacing to a depth of 0.070". The results are reported graphically in Vicker's hardness units with the corresponding HR15n and HRc hardness equivalents noted on the graph.

The effective case depth was determined per ASTM B721-91 using both the Remington specification minimum hardness of HR15n 88 (HRc 55 / HV_{500} 595) and the ASTM B721-91 general specification of HRc 50 (HR15n 85.5 / HV_{500} 513). The case depth was determined by projecting a line from the point at which each hardness curve passes through the appropriate hardness level to the distance from the edge of the part (x-scale). This value is considered the effective case depth.

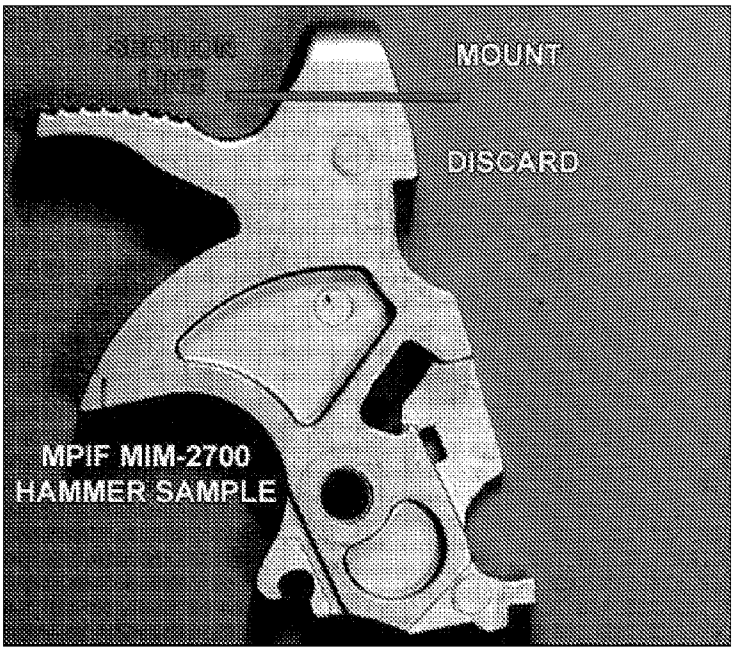

Figure 1. An image of one of the hammer samples and the location of the section line.

DETAILED RESULTS

Table 1 presents the Rockwell superficial hardness results. All of the tested sample met the Remington specification of HR15n 88-92. Figure 2 presents a graph of the HV_{500} hardness versus distance from the part

surface for the four tested hammer samples. The data indicates that the effective case depth of the parts using the Remington specification of a minimum effective case hardness of HR15n 88 (HV_{500}595) ranges between 0.008" and 0.011". The specification calls out a minimum effective case depth of 0.008" and these part meet this specification.

Based on the general ASTM specification of a minimum effective case hardness of HRc 50 (HV_{500} 513), the effective case depth ranges between 0.010" and 0.014". This effective case hardness can be used for high-wear components with moderate to heavy loads. The total case depth for all of the samples is approximately 0.036". The total case depth is the distance from the surface of the part at which the stable core hardness is achieved.

ROCKWELL SUPERFICIAL HARDNESS
MPIF MIM-2700 Hammer Samples

	Sample Hardness (HR15n)			
	Indent			
Sample ID	1	2	3	Average
1	90.0	90.3	89.9	90.1
2	90.3	89.8	90.4	90.2
3	90.3	90.9	90.5	90.6
4	90.2	90.4	90.1	90.2
Test Block	90.3	90.4	90.3	90.3
HR15n 90.2 +/- 0.7				

Table 1. Rockwell superficial hardness testing results on the provided hammer samples.

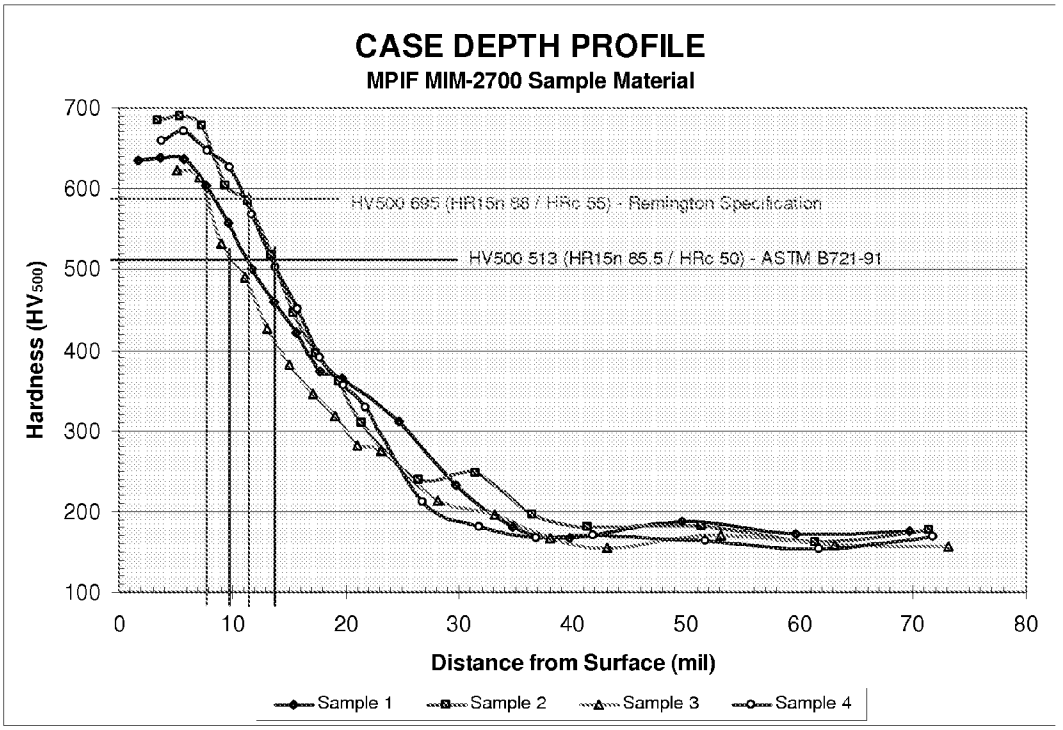

Figure 2. The case profile data obtained from the four test hammer sample test specimens.