

Table 4. 5W2H action plan in case of deviation

What?	Why?	How?	How much?
Stop at the insertion of the new rings in the process	Avoid discontinuity in the rings supply	Following Master Plan of Railway Maintenance (PDMF) providing rings in the maintenance.	Fitted backing rings 85.61 parts/month Surefit backing ring 110.17 parts/month Seal wear rings 231.06 parts/month
Limiting features for applying rings	To avoid discontinuity in the rings supply	Seeking resources with economic management	Fitted backing rings US\$ 25,242.85/month Surefit backing rings US\$ 9,094.94/month
Stop in the application of the ring selection coding.	To avoid loose ring in cartridge bearing and roller bearing.	Communication to bearings maintenance team the continuity	no cost
Untrained young employee in the process	To avoid loose ring in cartridge bearing and roller bearing	Training on the job the selection of all rings according to color coding.	no cost

9. Conclusion

The axis flexion is the largest responsible for the generation of groove, but due to its resolution in changing the design of the axle, it becomes something very expensive, then remains to control the dimension of the wear rings and backing ring to allow interference between them and the axis, eliminating the contact wear that originates the groove. Thus, maintaining interferences between these elements will be the way to avoid groove on axle.

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References

- Vale, *Training Yellow Belt Specialist Six Sigma Using Macrotab Soft*, 2nd Edition, São Luís – MA, Brazil, 2017.
- Trivellato, Arthur A., *Aplicação das sete ferramentas básicas da qualidade no ciclo PDCA para melhoria contínua: Estudo de caso numa empresa de autopeças*, Escola de Engenharia de São Carlos USP, São Carlos – SP, pp. 30, 36 – 39, 2010.
- Santos, Virgílio F. M. dos, *Como Elaborar um Box Plot? Aprenda em poucos passos*, Available: <https://www.fm2s.com.br/como-elaborar-um-box-plot/>, Apr 16, 2018.
- Camargo, W., *Controle de Qualidade Total*, 1^o Edição, IFPR e – Tec. Brasil, Curitiba – PR, 150 P., 2011.
- Lane, David M., Chi Square Distribution, Available: http://onlinestatbook.com/2/chi_square/Chi_Square.html. Apr 16, 2018.
- Schneider, H. and Silva, Charlei A. da, *O uso do modelo box plot na identificação de anos – padrão secos, chuvosos e habituais na microrregião de Dourados Mato Grosso do Sul*, Revista do Departamento de Geografia – USP, Volume 27, São Paulo – SP, pp. 131 – 146, 2014.

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