IDENTIFY CAUSES OF TIMING BELT FAILURE & TROUBLESHOOTING CHART

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ABSTRACT

This paper refers most responsible and exact causes behind the timing belt wear & damage due man, machine, method, material, measurement & environment. In short this paper demonstrates the causes and their effect on timing belt surface with the help of troubleshooting chart. This chart also gives the corrective action need to be taken over the particular cause. Basically this paper explains the causes and their effect more clearly with master ishikawa diagram for timing belt damage issues. It also includes wear, Belt tension on an improper ways, some hardware issues & effects of environment.

Keyword: *belt wear, troubleshooting chart, improper belt tension, environment effects, corrective action, master ishikawa diagram, hardware issues.*

INTRODUCTION

Timing belt drive is relatively new conception of power transfer, accepted in all areas of industry today. The power transfer through timing belt is relatively more efficient and affordable in comparison with other power transferring medium such as gears. Timing belt drives are compact and can be used in areas where less space is available for operation. Timing belts are flat and having series of equal spatial teeth inside addendum diameter. Timing belt transfers the torque by means of its shape. The teeth, equally spaced at inner side of timing belts, contact the belt pulley's teeth with their hollows between teeth and, thus, by conjugate gear action, achieve the meshing between the belt and the belt pulley and transfer the torque.

Considering their purpose and very important role in transmission of power and motion, it is necessary to adequately know tribological characteristics of timing belt. In spite of advantages in operation, timing belt drives have only recently achieved great application. Popularity of timing belts in automotive industry has accelerated their use in other branches of industry.

CAUSES BEHIND TIMING BELT FAILURE

A large number of causes have influence on the working life of the timing belt. Some of them are: -

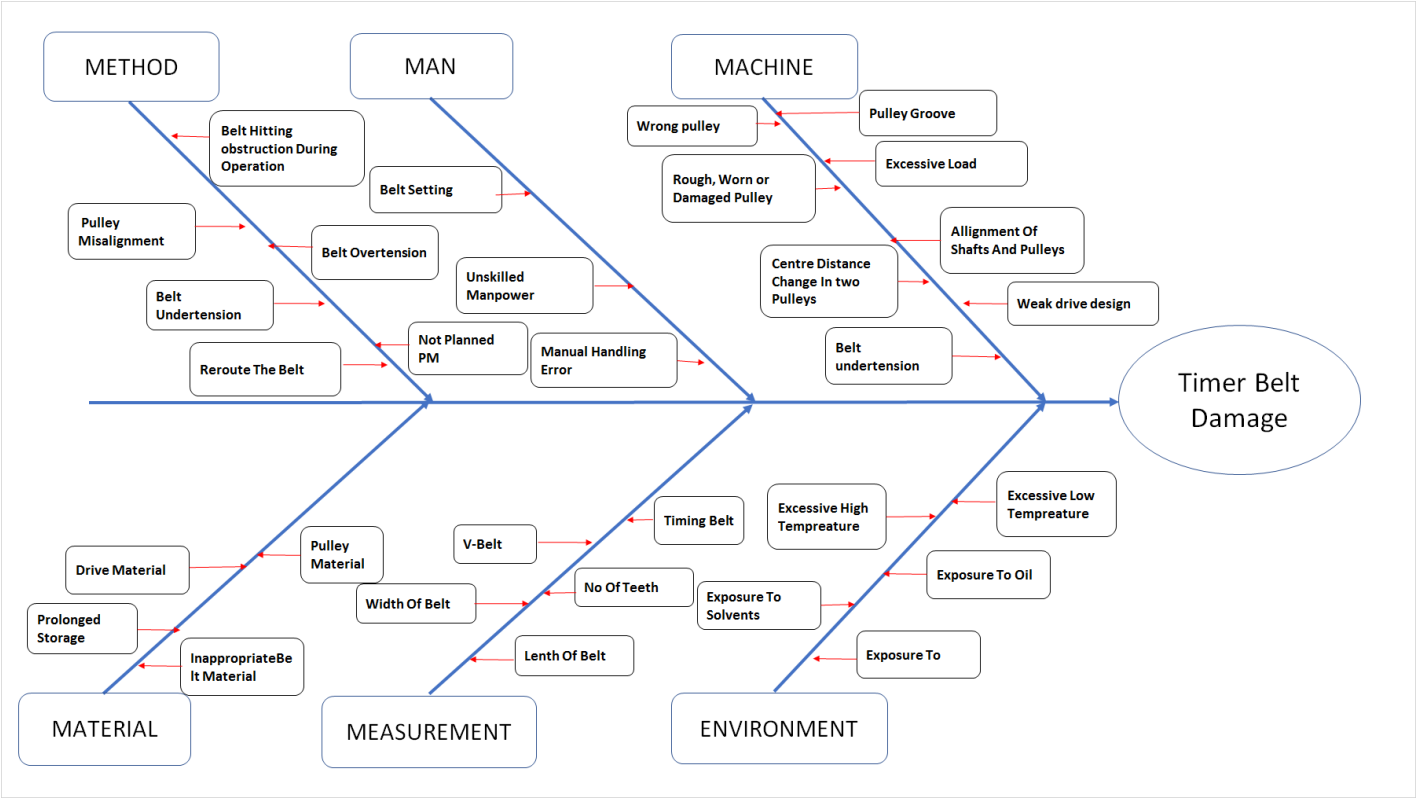
- The belt's tension,

- Coaxiality of the shaft and the belt pulley,

- Friction and wear in the belt- belt pulley contact,

- working environment.

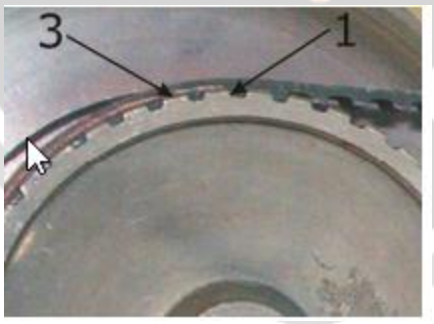
To find out the all causes behind the problem due various parameters such man, machine, method etc. the master ishikawa diagram aka causes & effect diagram is plotted as follows.



This above master ishikawa diagram includes nearly all the causes responsible for the timing belt damage.

Influence of friction and wear: -

Basic tribomechanical systems in timing belt are: belt's tooth [1] - belt pulley's tooth [3]. If these meshing are not proper there occur the friction between the belt surface and pulley and if these friction increases more than limit then the belt tooth starts wearing rapidly. Due to friction the temperature increases and so the belts tooth and back area starts cracking and deforming original shape and belt damages.



Probable causes: - Belt undertensioned, Seizure of driven part; Misalignment of shaft and pulley

Corrective action: - 1.check distance between two pulleys' and alignment, 2. Use tensioning gauge to set proper tension.

Influence of belt tension: -

The belt tension has the important role in the belt failure problem, Proper belt's tension provides normal coupling between the belt and the belt pulley. Checking of the belt's tension is done by tensiometer. Inadequate belt's tension reflects as insufficient or exaggerated belt's tension. Exaggerated tension of the belt leads to increase of power losses at idle speed and reduces the efficiency. In addition, if the belt is over-tensioned it leads to instant tooth wear, surface between tooth wear, usually called land wear. Increase in belt's tension directly

influences the kinematics of coupling between the belt and the belt pulley. Over-tension, as well as insufficient tension of the belt, may lead to too early failure of the timing belt drive.

Tensile Failure

Probable causes: - Misalignment of shaft and pulley, improper instrument / method used at the time belt tensioning.

Corrective action: - check alignment of shaft and pulley, use proper instrument for belt tensioning.

Working environment: -

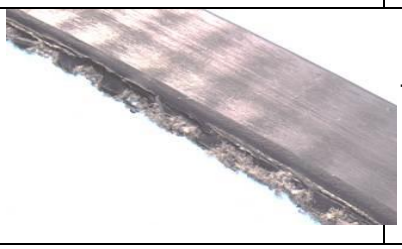
The timing belts are especially sensitive to high temperatures, action of chemical compounds and foreign bodies. Materials used for making of the belts are rubber, urethane (polyurethane), and neoprene and similar that is more or less not resistant to high temperatures. When rubber belts work at high temperatures for a long period, rubber compounds gradually harden, losing their features. The cracks appear at the back surface of the belt leads to belt failure.

Influence of oil & solvents on belts

Possible causes: - Exposure to oil, exposure to chemical, exposure to excessive low/ high temperature.

Corrective action: - Reroute the belt from exposure to closed area.

Other types of failure with possible causes & corrective action over them: -

Types of failure	Failure image	Possible causes	Corrective action
1. Rapid Edge Wear		- Belt Hitting Obstruction. - Pulley Misalignment.	- Remove obstruction or use idler to reroute the belt. - Correct pulley alignment.

2. Rapid Tooth Wear		- Belt Under tensioned. - Pulley Misalignment. - Excessive Load.	-Check distance between two pulleys, Alignment. - Align shafts and pulleys. - Check Alignment of shafts & pulleys.
3. Uneven Tooth Wear		- Pulley Misalignment. - Belt Under tensioned. - Rough Or Damaged Pulley.	- Align shafts and pulleys. - Check distance between two pulleys, Alignment. - Replace timing pulley.
4. Worn Or Cracks In Backing		- Excessive Low, High Temperature. - Pulley Diameter Sub Minimum. - Back Side Idler.	- Reroute the belt from exposure to closed area. - use proper specification pulley drive.
5. Apparent belt stretch		- Centre distance changed. - Weak drive structure.	- Check lock down bolts on motor &shaft. - Reinforce drive structure.

Conclusion: -

Timing belt is one of the best ways to transfer power & motion, but due to frequent failure of timing belts makes them less popular in automotive industries, and in other branches of industries. but most of failure problems of belts can be eliminated by eliminating the causes of the failure by taking preventive majors. These paper try's to cover most of the causes responsible for belt failure with the help of master ishikawa diagram, and also gives the troubleshooting chart for failure. After closely observation we can conclude that most of the causes are self-generated and can be eliminated if some precaution taken at the right time. Most responsible causes are: -

- Misalignment of pulley and shaft.

- Belt not properly tensioned.

- Exposure to environment.

- Weak drive structure.

- Improper handling and installation.

References: -

1. B. Stojanoviü, N. Miloradoviü: Development of timing belt drives, Mobility and Vehicle Mechanics, Vol. 35, No. 2, pp. 29-34, 2009.

2. https://www.gatestechzone.com/en/problem-diagnosis/synchronous-drive-system

3. B. Stojanoviü: Characteristics of tribological processes in timing belts (in Serbian), Master's thesis, Faculty of mechanical engineering from Kragujevac, 2007.