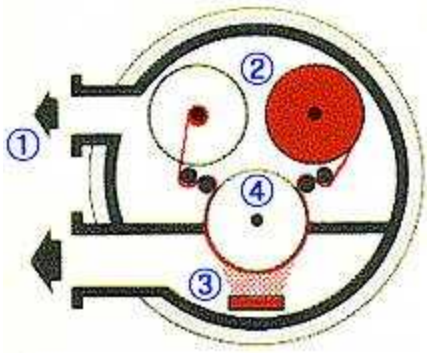
Measuring roll parallelism in a vacuum metallizing chamber using inertial alignment equipment

Introduction

Inertial technology allows for a distinctly new way of measuring parallelism of rolls. The measurement device contains three highly accurate ring laser gyroscopes for taking readings in three-dimensional space. With three gyroscopes in the same housing, it can accurately determine its position in space without the need for any line-of- sight or optics.

Vacuum Metallizing is the process of applying a very thin layer of metal over the surface of a plastic film by first converting the metal into a vapor and then depositing it over a fast moving web of plastic film.

1. Vacuum Pump: Maintains vacuum state.
2. Winder: Winds and releases film.
3. Vaporizer: Evaporate metal material for metallization.
4. Cooling Drum: Condenses the metal sprayed on the film and protects film from intense heat

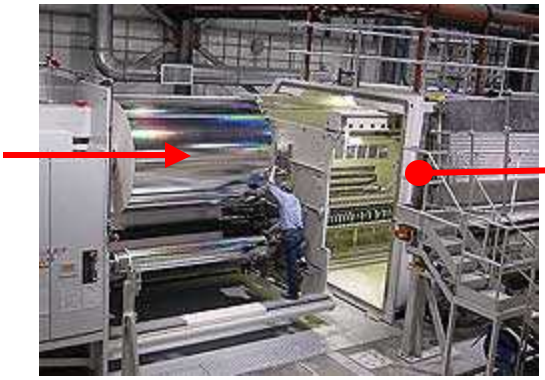


The rolls in a vacuum metallizer must be parallel within a certain tolerance or wrinkles will occur in the metallized plastic film. Wrinkles in the plastic film often result in the product becoming non-recyclable scrap which is costly.

Problem Statement

The Vacuum Metallizer machine consisted of 17 rolls that were between 143” and 163” long. The manufacturer required the rolls be parallel within .016” (.4mm) because the machine runs up to 2500 feet per minute. All of the 17 rolls move in and out of the vacuum chamber as a single unit on rails. The picture below shows the roller assembly of the vacuum chamber.

Rolls move in to the vacuum chamber in the direction of the arrow.

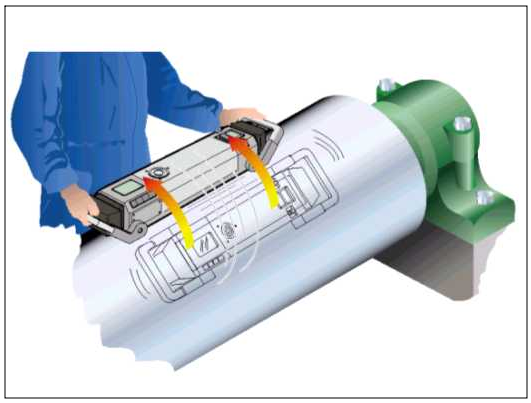


Vacuum Chamber (Fixed)

The roll assembly is in a different position when it is outside the vacuum chamber compared to when it is inside the vacuum chamber. Therefore it is necessary to measure the roll assemble parallelism while it is inside the vacuum chamber. The walls of the chamber prevented the use of any optical alignment equipment. Neither the equipment owner nor the manufacturer had previously been able to get the rolls parallel to the required tolerance, therefore the product had shown some wrinkling.

Approach

Inertial technology was used to measure the parallelism of the vacuum metallizer because is Inertial Alignment Equipment and not restricted by any optical means. The engineer rode, with the instrument in hand, on the roller assembly into the vacuum chamber. Once the vacuum chamber was in running position, the engineer took measurements with the inertial alignment equipment by placing it on the center of the roll and sweeping it approximately 20 degrees on the surface of that roll.



The rolls were measured in their running position. The Inertial Alignment equipment sent its data back to a laptop computer via a Bluetooth wireless connection. The laptop generated a graphic of the machine which stated how much each roll had to be moved at the bearing to bring them parallel with each other. Since these amounts were absolute values, the parallelism adjustments could be performed with the rolls outside of the unit. The representative from the manufacture was onsite and moved the rolls according to the inertial alignment equipments results. The engineer then rode on the roller assembly back into the vacuum chamber where the measurement process was repeated to check the results of the adjustments.

Conclusion

The roll assembly should slide into the vacuum chamber completely straight and level; however this is often not the case. Therefore it is necessary to measure the roll assembly parallelism while it is inside the vacuum chamber in running position. As the rolls are enclosed within a vacuum chamber, these measurements are nearly impossible with theodolites, and can be only marginally accomplished with pie tape, bubble level and sticks.

Inertial technology was used to measure the roll parallelism of the roll assembly while it was in the running position inside the vacuum chamber. The machine manufacturer used the values obtained to move the rolls parallel to each other. The results of the roll movements were checked with the instrument and the process was repeated until the tolerance was within the manufacturer's specifications. When the vacuum metallizer machine was started for production, it operated smoother than ever before, and with substantially reduced scrap due to minor maladjustments between rolls.