

Zero Leak in Tractors

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ABSTRACT

The concept of zero leak in tractors refers to the achievement of a completely sealed hydraulic system, where there is no fluid leakage from any of the hydraulic components. This can be accomplished by using high-quality seals, ensuring proper installation and maintenance, and incorporating advanced hydraulic technology. The benefits of zero leakage in tractors include increased efficiency, reduced environmental impact, reduce the customer complaints and improved safety. However, achieving zero leakage can be challenging, requiring careful design and manufacturing processes. Nonetheless, it is an important goal for the tractor industry, and ongoing research and development are focused on achieving this objective.

Keywords— Hydraulic technology, fluid leakage, high quality seals.

1. Introduction

Tractors are an essential part of modern agriculture, used for a variety of tasks, such as tilling, planting, and harvesting. The hydraulic system in tractors is critical to their operation, providing power to the implements and steering components. However, hydraulic leaks can cause significant problems, such as reduced efficiency, environmental pollution, and safety hazards.

To address these issues, the concept of zero leakage in tractors has emerged, where the hydraulic system is designed and manufactured to prevent any fluid leakage. Achieving zero leakage requires a combination of advanced engineering, high-quality components, and careful maintenance.

The benefits of zero leakage in tractors are significant. It can improve efficiency by reducing the loss of hydraulic pressure and minimizing the need for maintenance. It can also reduce the environmental impact of tractor operation by preventing fluid leaks that can contaminate soil and water. Additionally, it can improve safety by reducing the risk of hydraulic fluid spraying onto operators or bystanders.

Overall, zero leakage is an important goal for the tractor industry, and ongoing research and development are focused on achieving this objective.

2. Experimental Methods or Methodology



Fig 1. Leak Detection Methods

A. Vacuum Testing

Connect a vacuum testing device, such as a vacuum pump or vacuum gauge, to the testing points using appropriate fittings or adapters. Follow the manufacturer's instructions for connecting the equipment securely and properly.

Apply vacuum: Start the vacuum pump or gauge and apply a vacuum to the system according to the manufacturer's recommended specifications. This may involve applying a specific level of vacuum pressure and holding it for a designated period of time.

Monitor for leaks: Monitor the system for any signs of leakage during the vacuum testing process. This may include observing pressure gauges or using leak detection tools, such as soapy water.

B. UV Testing

Use a UV light or UV lamp to inspect the tractor's hydraulic or pneumatic system for any signs of leaks. The UV leak detection material should fluoresce or emit UV light when exposed to the UV light or lamp, indicating the presence of leaks.

Record results: Record the results of the UV leak testing, including any observations of leaks, locations of leaks, and any other relevant information.

3. Industrial Problem Statement

A. Compact Tandem Pump to Bottom Joint Leak

B. Compact Return Line Hose Leak

C. Fuel Cork to Hose Joint Leak

D. Triangle Dummy Plate Gasket Broken

E. Hydraulic Oil flow Pipeline Adaptor Oil leak.

A. Compact Tandem Pump To Bottom Joint Leak

A compact tandem pump is a type of hydraulic pump commonly used in tractors to provide power to the steering and hydraulic systems. The bottom pipe joint of the pump can develop leaks, which can lead to a loss of hydraulic fluid and reduced pump performance. To address a leak in the bottom pipe joint of a compact tandem pump in a tractor.

1. Insufficient torque: If O-ring seals are not properly torqued during installation, they may not provide adequate sealing, resulting in leaks. Insufficient torque can cause the O-ring to deform, lose its sealing properties, and allow fluid or air to escape. Torque spec value is 9 To 12Nm if below this value means leak occur.

2. CED (Cathodic Electro Deposition) paint burrs: CED is a common painting process used in automotive and tractor manufacturing to provide corrosion resistance. However, if not properly managed, CED paint can accumulate in the O-ring seal areas and create burrs or debris, which can compromise the sealing integrity of the O-ring and lead to leaks.

3. Improper O-ring groove design: The design of the O-ring groove, including dimensions, tolerances, and surface finish, is critical to ensure proper sealing. If the O-ring groove is not designed correctly, it may result in improper compression or deformation of the O-ring, leading to leaks.

4. O-ring material or quality issues: O-rings are made from various materials, and their quality can vary. If the O-ring material is not compatible with the fluid or gas being sealed, or if the O-ring has defects or damage, it may not provide an effective seal, resulting in leaks.

5. Assembly errors: Errors during assembly, such as improper alignment or positioning of O-rings, incorrect installation techniques, or lack of proper lubrication, can lead to leaks in O-ring seal areas of tractors.

B. Compact Return Line To Hose Joint Leak

- A compact return line hose in a tractor is a specific type of hydraulic hose that is used in the tractor's hydraulic system for the purpose of returning hydraulic fluid from the hydraulic components back to the reservoir or tank. These hoses are designed to handle the return flow of hydraulic fluid at lower pressure levels compared to other hydraulic hoses in the system.

- Compact return line hoses are typically made of synthetic rubber or thermoplastic materials, reinforced with one or more layers of braided or spiral-wound high-tensile steel wire, which provides strength and durability. They are often designed to be flexible and resistant to abrasion, oil, and other hydraulic fluids to ensure reliable performance in harsh operating conditions.

- Compact return lines in tractors may experience high pressure or temperature conditions, especially in heavy-duty applications. These extreme operating conditions can cause hoses or fittings to weaken or fail, resulting in leaks. Compact return line hoses made by nitrile neoprene material it cant withstand the temperature of 130 degree Celsius for 2hours so it causes expanded the hose and its effect for the leakage occur and also low torque issue in this joint, Torque spec value is 4-6Nm.

C. Triangle Dummy Plate Gasket Broken

- A triangle dummy plate in a tractor refers to a triangular-shaped plate or bracket that is used for mounting or securing various components or accessories on a tractor. It typically has three holes or slots that allow for attachment points, and it is commonly made of metal or other durable materials.

- Triangle dummy plate crack issue due to the retorque values is too much and also N8052 Gasket material not withstand the oven temperature of 130-degree Celsius and torque spec value should be a 46Nm but pretorque value is exceed the spec value so that crack occur.

D. Fuel Cork to Hose Joint Leak

- Fuel hose joints in tractors can come in various types and configurations, such as straight, elbow, tee, or Y-shaped fittings, depending on the specific fuel system layout and requirements of the tractor. These fittings are typically made of materials that are compatible with the type of fuel being used in the tractor.

- This leak occur due to the Low torque and also mating issue . The mating issue occur due to the using of manual spanner.

E. Hydraulic Oil flow Pipeline adaptor oil leak

- Hydraulic oil flow pipeline adapters in tractors typically consist of metal fittings or connectors that are designed to be compatible with the hydraulic lines or hoses used in the tractor's hydraulic system. They may have threaded or quick-connect ends that can be screwed or snapped into place, respectively, to establish a secure connection. Some adapters may also include seals or O-rings to prevent hydraulic fluid leaks.

- This leak occur due to torque value inconsistency, torque spec is 65Nm not maintained and also other cause is oil accumulate in O ring seating area so that leak occur.

4. Results and Discussion

Table.1. Summary of Action

S No	Causes and Recommended Measures		
	Issues	Root Cause	Action
1	Compact tandem pump bottom pipe joint leak - CED	No dedicated masking to prevent paint deposition on mounting surface	Masking pipe is tested after that no issue in this joint
2	Compact Return line hose leak	Torque value reduced after oven heating and also Nitrile neoprene material does	Set of gun is implemented and EPDM Material

S No	Causes and Recommended Measures		
	Issues	Root Cause	Action
		not withstand oven temp(130 Degree Celsius)	used for hose
3	Triangle Dummy plate Gasket broken	Gasket broken after retorque	Gasket material is changed N8052 and also set the alarm to prevent the exceeding of spec value
4	Fuel cork to hose joint leak	Low torque	Torque wrench device implemented
5	Hydraulic oil flow pipeline adaptor oil leak	Low torque , accumulated Oil not cleaned in O ring seating area	Pneumatic washer installed and also torque wrench is advised to use properly

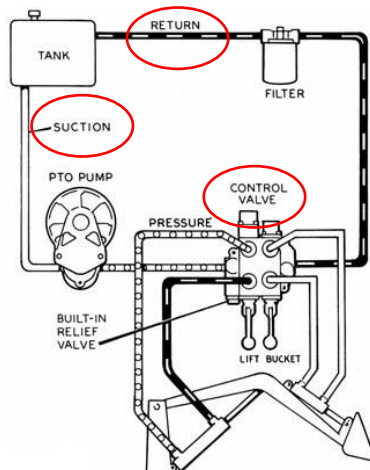


Fig. 3. Major leakage occur in a tractor

4.1 PPM Calculation

This graph represents the parts per million reduction value in industry, PPM is calculated by **Total number of occurrence / Total number of production * 10lakh**

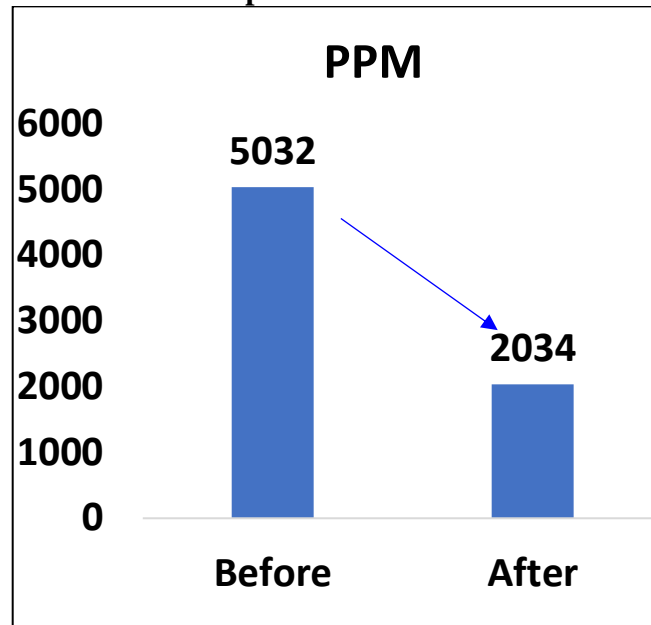


Fig. 4. PPM Graph

CONCLUSION

In conclusion, achieving zero leakage in tractors is an important goal for improving efficiency, reducing environmental impact, and ensuring the safe and sustainable operation of agricultural machinery. Zero leakage refers to the absence of any fluid or gas leaks from various systems in tractors, including hydraulic, fuel, coolant, and exhaust systems.

- There are several key benefits to achieving zero leakage in tractors. Firstly, it helps to minimize fluid waste and associated costs, as well as prevent contamination of soil and water sources. Secondly, it enhances tractor performance and reliability, as leaks can result in decreased efficiency, reduced power, and increased downtime for repairs. Thirdly, it promotes environmental sustainability by reducing greenhouse gas emissions and minimizing the ecological footprint of tractor operations.
- Achieving zero leakage in tractors requires a multi-faceted approach that includes regular maintenance, proper installation and sealing of components, and the use of high-quality materials. It also involves effective monitoring and detection of leaks through advanced technologies and proactive measures, such as routine inspections.

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