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End Of Line Test System:

1.1. Operation:

The purpose of the test system is to check any visual, audible or other problems which may occur during installation and assembly of the axle and/or similar systems.
In order to make a successful test, a predefined scenario is prepared by authorized personnel (different levels of user authorization is defined in user control software) (rpms & time) and loaded to the test system. For different testing conditions, different scenarios can be prepared and later selected by the testing operator.

The axle under test is automatically or manually loaded to bench and fixed correctly with the stand and motor. Necessary sensors such as thermocouples and encoders are mounted. When the axle is ready for testing, the operator reads in the barcode number with a wireless barcode scanner or manually types in serial number and selects the required test plan. The test starts and operator observes the product during testing for any unexpected noise, vibration and checks the systems for any leakages.

During testing, the operator should stand out of the testing area. Testing area is designated with a fence and when the door is open, test will not start running. All operator controls are out of the fence. In case if the fence is not locked, a warning will be shown on the system. In order for a test to start, all safety fences should be locked. Also, the system continuously checks for PC-PLC-Server connections. In case if there is a problem with the connection, a warning will appear on the message window and the test cannot be started.

If the product is brand new and has no pre-established test plan, then a warning will appear asking for a new test plan or to select from one of the existing test plans (with the read in barcode, software decides which scheme to run).

When the test is completed, a green light on the fence will turn on and a warning message will appear on operator panel. The product will be manually removed. In case if the test is acceptable, then the operator will select approve and the data will be logged (in both approve and disapprove cases, the data will be logged for control purposes).

Operator can conduct various operations detailed in Section 2 under operator panel layout. When the test is completed and approved, the data will be sent to the company servers and the reports are automatically generated.

1.2. User Interface:

1. Motor rpm and torque values
2. Inverter current, voltage and power levels
3. DAQ Values
4. Barcode number
5. Selected test scenario
6. Total number of items tested
7. Resetting total number of items tested
8. Operator name
9. Recent warnings and error messages
10. Test Start / Stop

Connections is regularly checked and when established the PC user interface will change into active mode. Otherwise, the screen will be passive and not open to changes. Connection status information and other data will be visible to user in Messages List Box (9).

Historical data is logged into the local computer and to the company server. This data may be used to compare the updated data against the historical data so that the operator easily checks if the axle under test is in between these statistical limits. All other detailed analysis and detailed reporting can be done using the logged data.

Test operators is also logged with their names. In case of a problem, the whole log will be reachable at any time with the operator information. This includes rejected and accepted tests. When the test duration is finished (estimated 5 minutes) and the required data is collected, the test operation is saved with a name including barcode number, test date and time, test scenario under Log folder. When the data is saved to company server, it cannot be changed or edited. It is only possible to change or edit with a different name and with authorized personnel.

Defining of test scenarios are given in the following figure;

Test scenarios are planned using this screen. Initial test plans should be discussed and added to this document. Once the test plans are checked, updated and loaded, `active plan` button should be clicked and the test runs under this scenario.

With the selection of test plan as shown in Figure 4, the test is ready to run. Directions RWD "<<" or ">>" FWD can be selected by clicking on the corresponding button.
When the direction is selected, a final approval screen pops up. The operator should click on the approve button to continue with testing.

Test scenarios is transferred to PLC and the motor is controlled depending on the test scenario values. In case if a deviation is observed from the test scenario, the test will be stopped and labeled as `unsuccessful test`.

If the test runs as planned, `successful test` message will be shown and the test can be finalized.

With the completion of the test, a report is automatically generated. It opens instantly and is called `final test report`. This report is always reachable online and from mobile. In case if necessary, the operator may comment on the `operator explanations` table and can be saved.

1.3. Safety:

Safety items used in the bench:

- **Emergency Stop:** One on panel, one on the bench.
- **Safety relay:** In case if an emergency button is pushed or the fence sensor is on, without resetting the system, test bench is not operational.
- **Fence sensor:** In case if the fence door is not closed, bench will not be operational.
- **Motor control:** In case if the current gets higher than a specified limit, drive motor stops.
- It is not possible to reach moving parts when the test is running.
- In case if one of the safety buttons is pressed, or is not operational, or if the operator does not initiate the test, the system is not going to be operational.