In-house Test Rig Facility for Pot Tending Machines

Bienvenido Jr. Borres Mendez[1] and Jasbant Pradhan[2]
1. Senior Instrumentation Technician
2. Supervisor, crane maintenance team
Emirates Global Aluminium (EGA) Jebel Ali, Dubai, United Arab Emirates
Corresponding author: bmendez@ega.ae

Abstract

Technology allows us to use a remote controller to fully operate pot tending machines (PTMs). Newly arrived brand new and repaired PTM remote controllers must be fully function tested before they are allowed to replace and be used in the pot lines. Testing these remotes should be safe, reliable and hassle-free. Hence, an in-house test rig facility specifically designed to test this type of remote controller was conceived and constructed to satisfy the requirements of a full function test. The test rig facility, which has been carefully designed, commissioned and approved before putting it to use, has eliminated the need of a PTM to be transferred to the maintenance bay area to install and test a new or repaired remote controller. It also eliminated the risks involved in doing the task. Testing the PTM's remote control system is simplified into plugging into te test rig facility the remote controller's receiver, open the corresponding software, go online and start full function test.

Keywords: PTM remote controller, PTM remote control test rig facility, PTMe remote control function test, PTM maintenance bay, PTM remote control receiver.

1. Introduction

Emirates Global Aluminium (EGA) is one of the aluminium companies who still uses first generation PTMs with remote control system as an option to fully operate a PTM as shown in Figure 1.

Figure 1. Pot tending machine operated from a remote controller.

Using a remote control to operate the PTM enables the operator to have a better vantage point at a safe distance. This remote control is mainly used during metal tapping, bath tapping, metal pouring, bath pouring and beam raising.

A PTM remote control set consists of two main parts; the receiver unit which will be installed on the crane (Figure 2) and the transmitter box which is the remote controller (Figure 3).

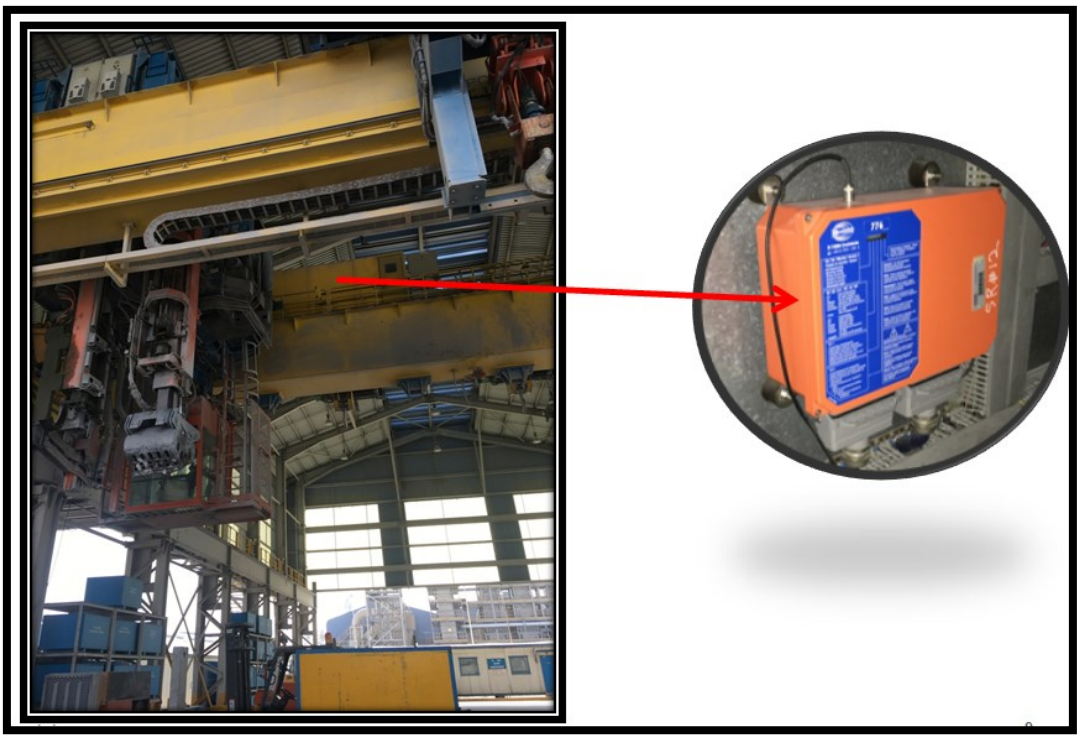

Figure 2. Remote control receiver installed inside the PTM electrical room.

Figure 3. Remote control transmitter.

2. Remote Control Replacement

Due to continuous usage of these remote controls, natural wear and breakdowns are bound to happen which requires a replacement. A spare remote control set should be ready and in standby to avoid long breakdown period. These standby remote control spares may be brand new or repaired units. They must be already pre-tested, declared safe and fully functional before allowing them to be used in the potlines. The removed remote control set will then be repaired in-house if the issue is minor and will be sent outside for major repairs.

3. Spare Remote Control Set

A brand new or a repaired remote control set must be fully functional, safe to use and fully tested before it will be accepted as part of quality inspection to ensure flawless operation in time that it is required to be used.

The previous procedure of testing a crane remote control set required a PTM taken away from the production and transferred to any available PTM maintenance bay with a transfer gantry. Once the PTM is safely transferred, barricaded and insulated, the remote control receiver unit will be installed on the crane's electrical room located approximately 10 meters above the ground. The technician will then commence the full function test of the crane remote control by actually operating the crane. These function tests are very crucial in preventing a possible accident involving the crane in the potlines caused by a fault in the installed remote controller.

4. Major Issues and Risks Involved in Testing a Crane Remote Control Set

The following issues and risks need to be addressed:

a. Availability of a PTM. Potline production usually cannot spare a crane that can be used for testing a remote controller due to production requirements. This causes delays in warehouse quality inspection and material acceptance.
b. PTM transfers from pot lines to the PTM maintenance bay and vice versa using a transfer gantry takes a lot of time, at least two maintenance crews, and involves risks in the crane transfer such as working under suspended load (which is forbidden), pinching, exposure to heat and minor injuries.
c. Installation of the remote control receiver which weighs approximately 15 kg, on the crane electrical room at approximately 10 meters above the ground involves risks of working at height.
d. Live function testing especially of a repaired remote control set on an actual crane may cause accidents if the unit to be tested had any problem. This is the very reason why we needed to test the remote control set prior to letting it be used in the potlines.

5. In-house Test Rig Facility for Crane Remote Control

After consideration of the established issues and risks involved in previous procedure in testing of a new or repaired crane remote controller, we were determined to find an innovative solution that will completely eliminate the risks and issues involved in performing this task. And the result is an in-house test rig.

We have constructed a fully functional in-house test rig facility in the maintenance bay that is specifically designed to effectively test a crane remote control set. We incorporated the remote control test rig logic into the Programmable Logic Controller (PLC) unit that was already available on the maintenance bay instrumentation service table. We also integrated the interface

to a software that is already available in our service laptop which can connect online to the PLC via Wi-Fi connectivity. This set-up allows the technician to easily test full function of the crane remote control set without bringing in a crane from the potlines. The technician only has to plug in the remote control receiver into the test rig with the provided control plugs, run the software we made on the service laptop, connect wirelessly online to the test rig and the technician can now see each function of the remote control which will highlight in the service laptop interface corresponding to the function on the remote controller that was activated. The test rig facility is shown in Figure 4.

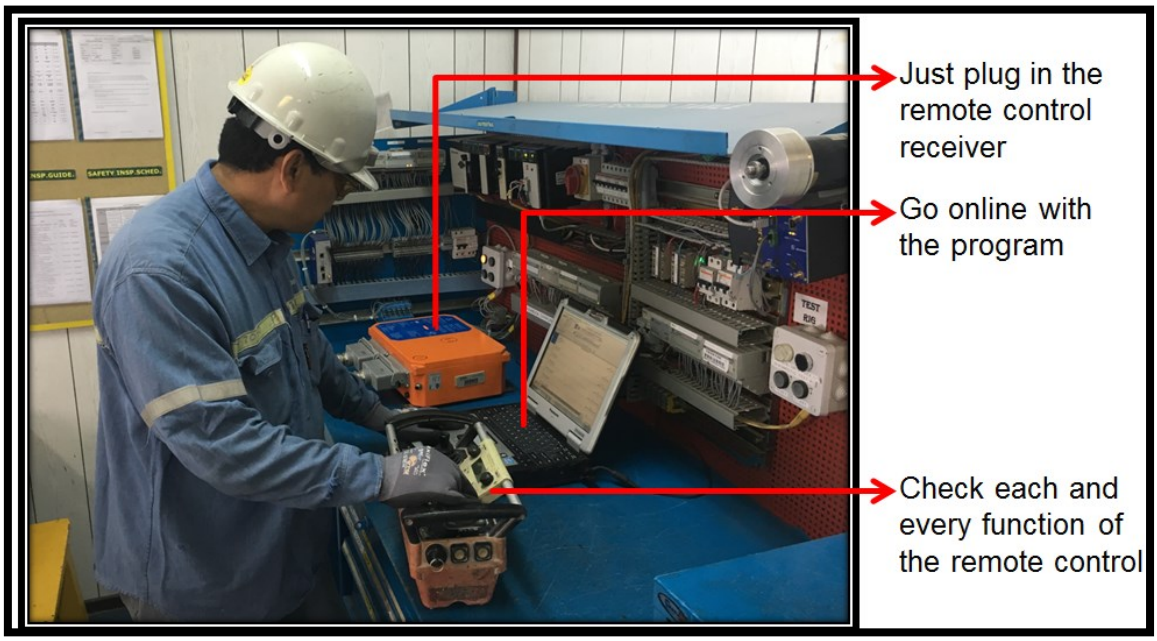

Figure 4. PTM Remote Control Test Rig facility set-up.

The interface on the service laptop mimics the actual remote controller and highlights the function that is currently activated as shown in Figure 5.

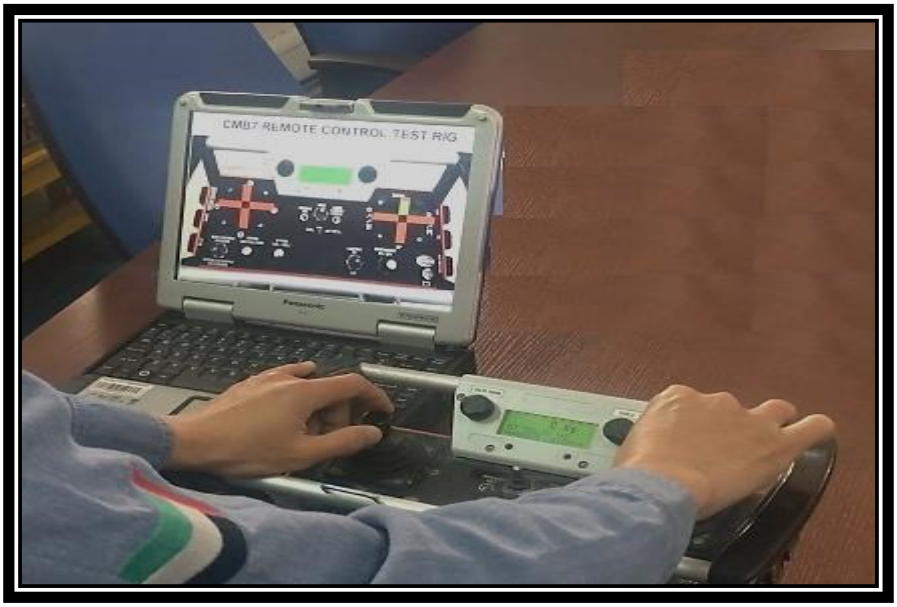

Figure 5. Service laptop interface for testing of PTM Remote Controller.

5.1. Examples of Test Sessions

Example 1:
A new remote controller arrived to stock and the warehouse requested to inspect the material and update to accept to stock. To test the complete functions of remote controller required for PTMs, we need crane availability which includes crane arrangement operation re-schedule, crane transfer, installation and test. To overcome the requirement of crane availability on site the test rig will help. We will connect the receiver unit to the test rig plugs and start testing. During the test we can see the following:

- Emergency push button activated/de-activated,
- Joystick analog values,
- Push buttons activation and de-activation as per required specification,
- Toggle switch operation, etc.
- Another important inspection is for remote transmitter display; it should display the correct alarms as per configuration and display the tools selection.

During the test we found toggle switch output was not available, we continued to test further and found display selection switch was not activating sometimes. We put a tag on the remote controller and informed the warehouse to send back the remote controller and get new spare one.

Example 2:
A remote controller arrived after repair from local support of the original equipment manufacturer. We needed to test the remote controller before acceptance. The designed test rig helped to test the repaired remote controller unit without the requirement of a crane. Some of the peculiar problems we found during the test were:

- Emergency switch activated signal at receiver end but physically the emergency push button was in release condition,
- Joystick analogue signal was not linear,
- While rotating the tools selector switch, the display did not show the next selected tool but jumped to the one, which was one step further ahead,
- Communication between transmitter and receiver was interrupted in-between the test processes, etc.

The above findings will help inspecting the remote unit without crane physical requirement and test the remote unit before accepting it to stock as a spare unit.

6. Conclusion

This in-house crane remote control test rig facility is a success. It eliminated all the established issues and risks that existed previously in testing a crane remote control set. This task is now carried out in a more effective, safe and efficient way.