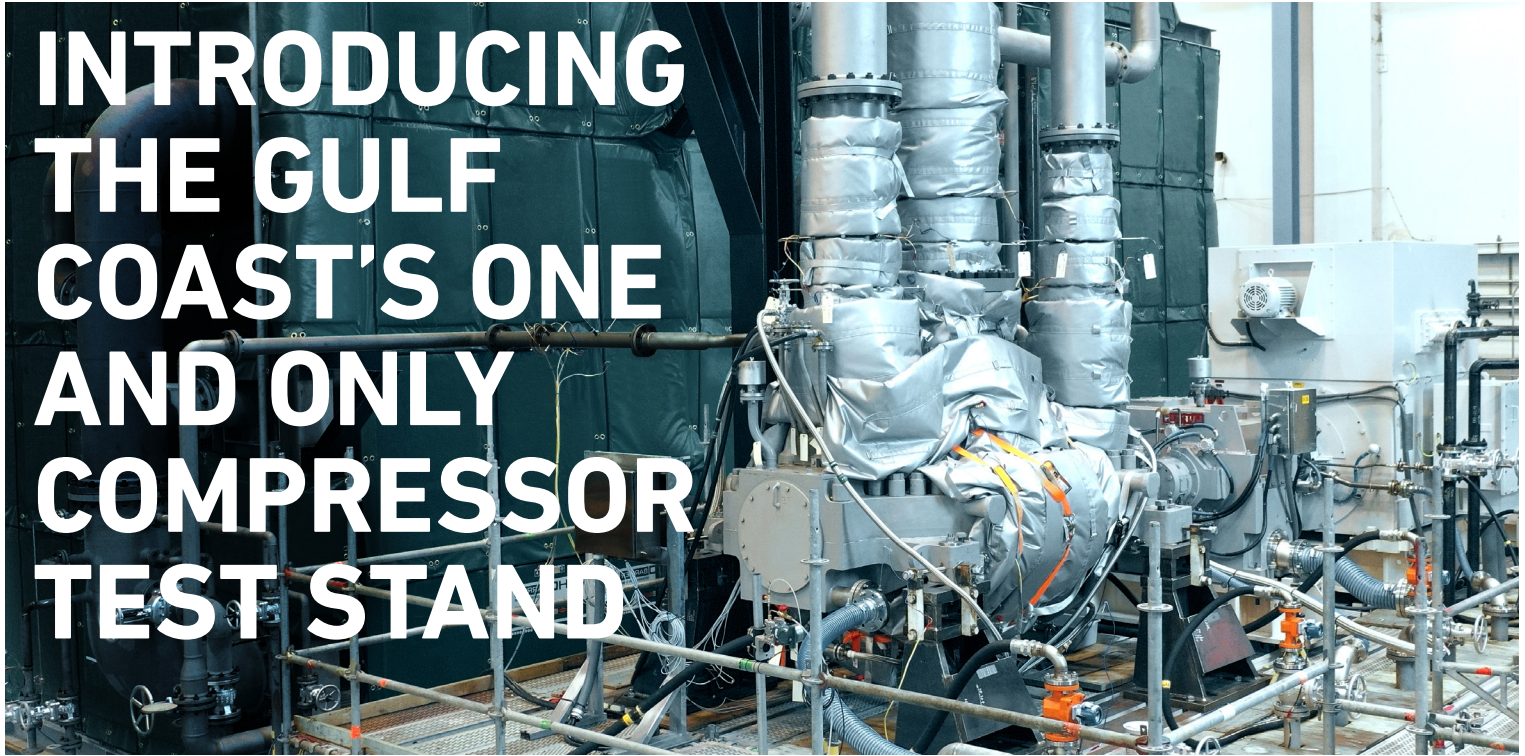


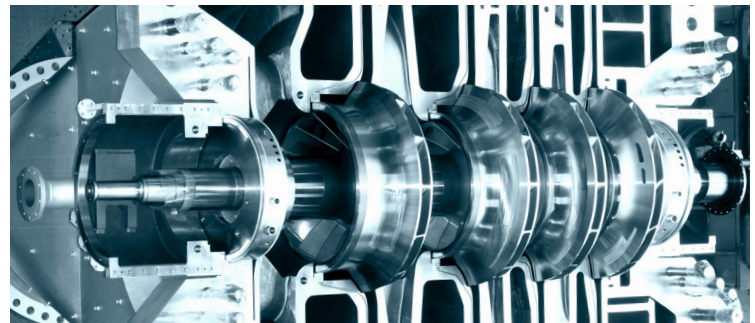
# INTRODUCING THE GULF COAST'S ONE AND ONLY COMPRESSOR TEST STAND



**MHI Compressor International Corporation's first test stand demonstration test was successfully completed in June 2020, securing MCO-I's position as the only company equipped to manufacture, assemble and test centrifugal compressors on the US Gulf Coast**

MHI Compressor International Corporation (MCO-I) is a leader in the design and manufacture of compressors, steam turbines and associated auxiliary systems. In 2015, MCO-I began operations at its Pearland Works facility, on the outskirts of Houston, Texas, U.S. The complex handles parts manufacturing, packaging, shipping, procurement, storage, service and maintenance of compressors and mechanical drive steam turbines and was the first U.S.-based manufacturing and service location for the Japanese-owned company, which previously housed all manufacturing capabilities in Hiroshima, Japan. This marked the completion of phase one of the company's two-part plan for the Houston-area site. The second phase is now complete, with MCO-I expanding its facility to offer testing and full manufacturing capabilities.

Every compressor that MCO-I manufactures is custom made and designed precisely around the unique process conditions of a petrochemical plant, fertilizer refinery or others. As is standard in industry, a customer will not take the risk of delivering the compressor to their plant without it first being verified to perform in the scenario for which it was designed. Therefore, accurate and reliable mechanical running testing is a mandatory API 617 requirement, while performance test is highly recommended. Performance test according to ASME PTC 10 is to verify/demonstrate compressor aerodynamic and thermodynamic performance is within the contractual guarantees before it is shipped to the client for installation.



## **THE LAUNCH OF A NEW TEST STAND**

The ASME PTC 10 test code includes two types of tests. A type 1 test must be conducted on the specified gas with a limited deviation between tests and specified operating conditions. The PTC 10 Type 2 test permits the use of a substitute gas when testing and extends the permissible deviations between test and specified operating conditions. This test is used when design gases are hydrocarbon mixtures that are toxic, explosive or otherwise difficult to replicate under test conditions.

In 2020, MCO-I launched a new performance test stand for API617 centrifugal compressor testing at the Pearland Works in Houston. The new test stand conducts PTC 10 Type 2 performance testing and mechanical run tests on small to mid-size compressors, for the upstream, midstream and

downstream oil and gas applications. The test stand includes closed loop system, double ended motor drive, multiple gearboxes and associated auxiliaries that are capable of testing small-to-medium sized horizontally split and barrel compressors. The new Gulf Coast test stand means MCO-I can now execute as a full service factory that can manufacture, assemble and test centrifugal compressors for its Gulf Coast customers.

### TEST STAND DEMONSTRATION TEST

A test stand demonstration test was developed to prove that the MCO-I Pearland Works service facility could perform the PTC 10 Type 2 performance and mechanical run tests effectively. The method of proving this was to use MCO-I's own equipment to demonstrate efficacy by verifying that the new MCO-I shop test result matched the previous MCO shop test result, obtained from MCO's facility in Hiroshima, Japan. MCO has tested more than 1,000 compressors, and these compressors have consistently fulfilled their function onsite. In order to prove the justification of MCO-I shop test facility, comparison of the two shop test results was deemed to be valuable.

The compressor was tested at the MCO shop and the performance was certified by a witness test in 2015 for another client. MCO-I applied the same concept of piping arrangement (Figure 1 & 2) and test condition as the MCO shop test condition per PTC-10. The first test stand demonstration test was successfully completed in June, 2020.

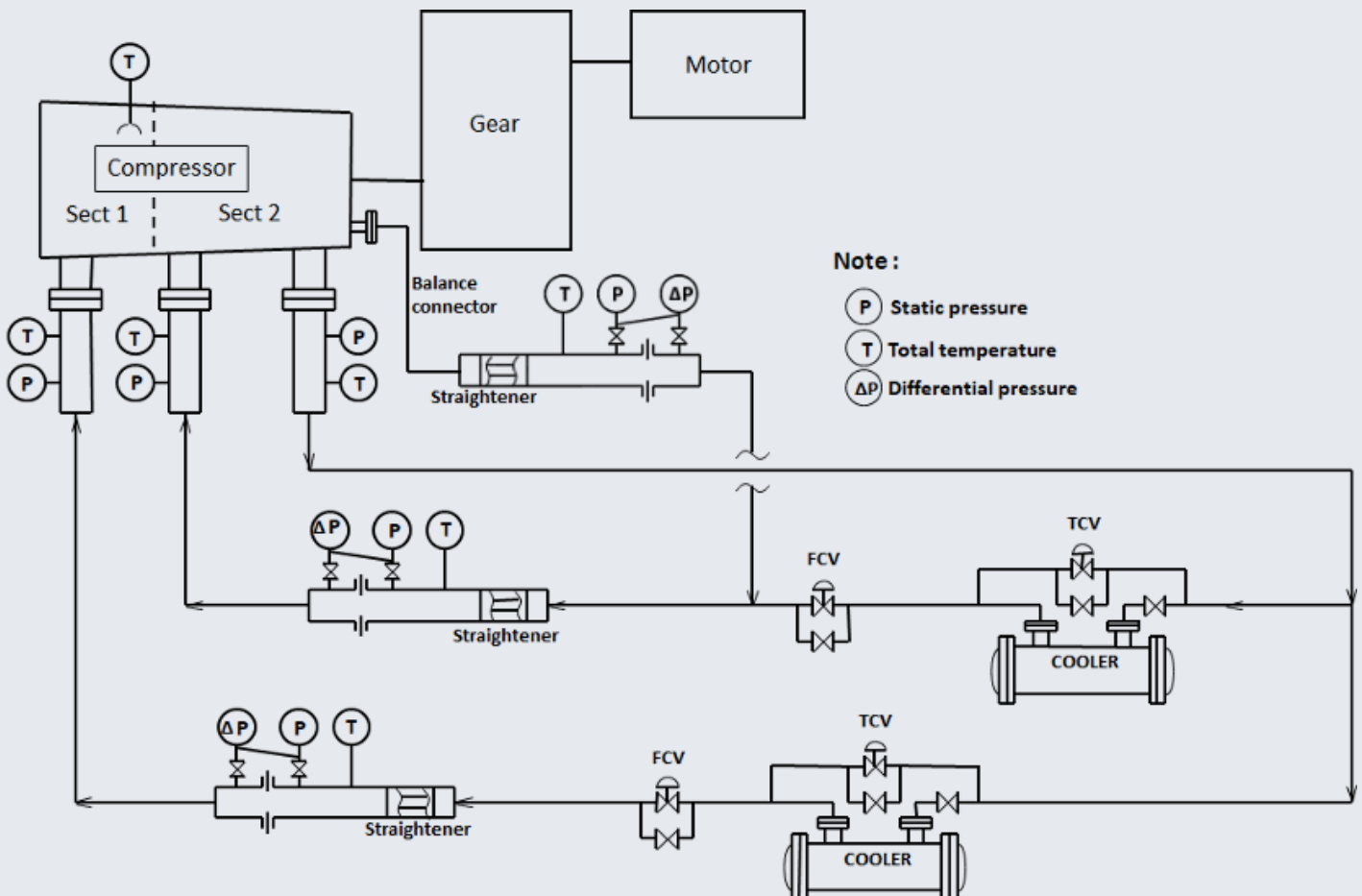
Figure 3 shows MCO test results and MCO-I test result of discharge pressure, polytropic head and gas power for each compressor inlet flow capacity. As demonstrated in Figures 3, the MCO-I shop test result matched the MCO results, verifying the accuracy of the Gulf Coast test stand.



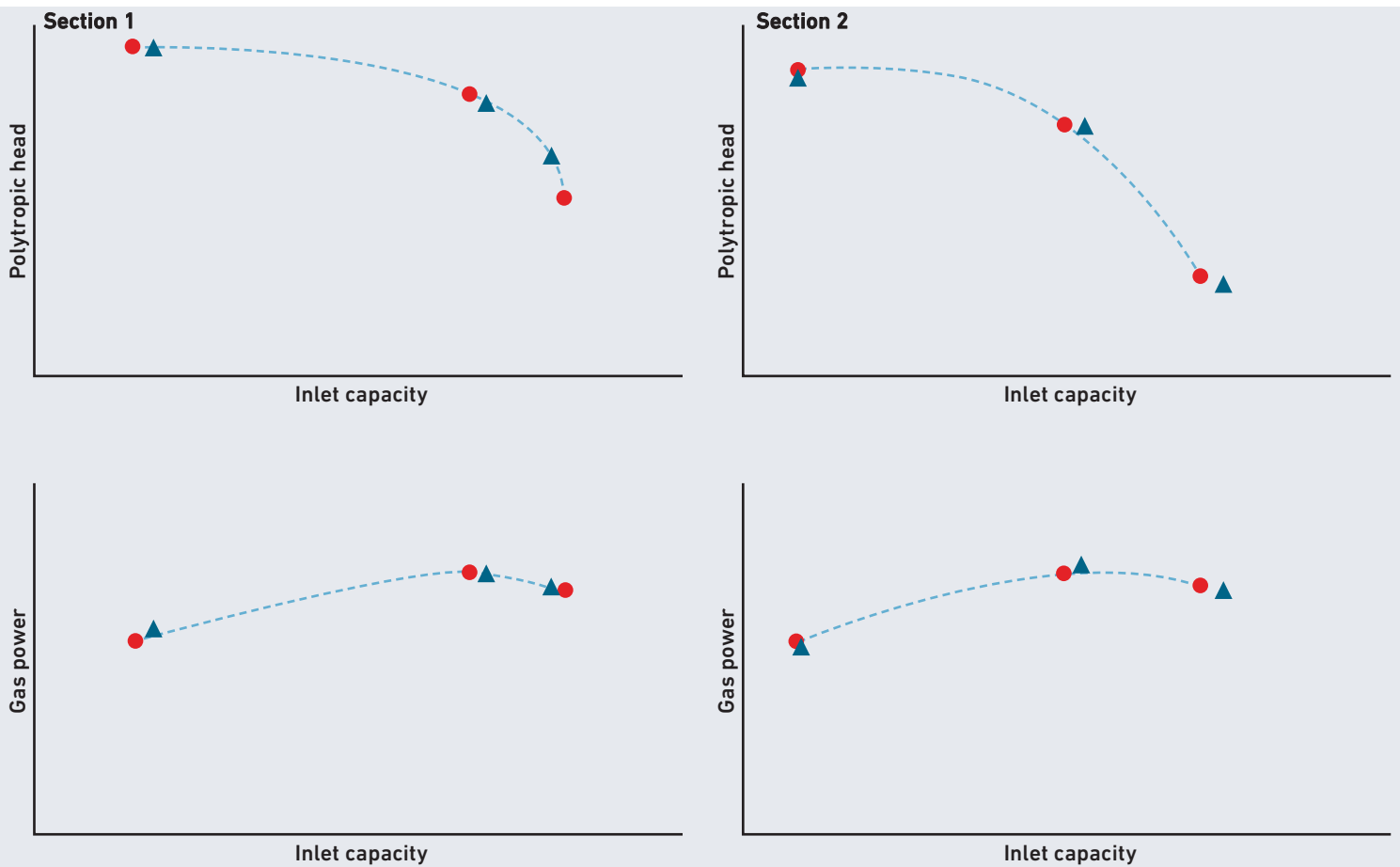
### MCOI SHOP TEST CAPABILITY

Compressor Type	Barrel & Horizontally-split Compressors
Compressor Nozzle	Both up and down nozzle configurations
Applicable Test	ASME PTC-10 Performance test API 617 Mechanical running test
Applicable Test Gas	R-134a, CO2, N2, He

**Figure 1.** Compressor module & specifications ready for demonstration test.



**Figure 2.** Piping arrangement for demonstration test. The test stand loop consists of inlet flow meter, heat exchanger and discharge.



**Figure 3.** Demonstration test results, showing MCO test result and MCO-I test result of discharge pressure, polytropic head and gas power for each compressor inlet flow capacity which are normalized by MCO shop test result of specified test point. Because of purpose of this demonstration test, MCO-I measured 3 points per 1 section with 100% rotating speed. For normal project, MCO-I measures 5 points per section per PTC-10 requirement to complete the compressor performance curves, and the other measurements and measurements at other rotating speed are measured based on the contract/customer requirement.

## BENEFITS FOR THE CUSTOMER

Prior to the introduction of the test stand at MCO-I Pearland Works, customers would have to travel to MCO's Hiroshima, Japan facility to oversee tests. The new localized offering means that U.S. customers will benefit from much shorter project lead times, allowing for quicker time to market. Customers will be able to minimize schedule risks due to simplified logistics to site for installation and commissioning. They will also be able to receive a swifter and more comprehensive explanation of shop test results and will benefit from the ability to witness shop tests close to home – lowering costs involved in traveling nationally or internationally to witness inspections and tests. Overall, access to the new Gulf Coast test stand has the potential to save a customer in the region of hundreds of thousands of dollars.

Now, more than 90% of the test stand's customers are located within a 300 mile radius of the facility, which provides them significant advantages when it comes to new equipment manufacturing and execution and servicing machinery throughout its lifecycle. Additionally, due to close proximity to existing plants, MCO-I will be able to offer performance testing and mechanical runs of compressors that have been revamped and/or significantly modified, all within a tight customer turnaround schedule.

## A TRACK RECORD OF U.S. INVESTMENT

MCO-I has made substantial investments in the U.S. Gulf Coast over the last few years while many others have relocated their manufacturing facilities overseas. The new test stand means the Gulf Coast region now boasts the presence of a global compressor manufacturer with a significant regional presence. MCO-I will be the only centrifugal compressor OEM in the region with performance test stand capabilities. As the only OEM to have a compressor test stand performing PTC 10 Type 2 testing in the Gulf Coast region, MCO-I will be able to manufacture, assemble and test exclusively within the U.S. MCO-I estimates that it will employ more than 200 people in the Houston area at its Pearland Works, with a focus on engineering and machining positions.

## OUTLOOK

MCO envisions substantial growth in the North American market for both new equipment and the after-sales service business, given the 319% increase in total machines installed since operations began in the US. Whereas MCO-I's competitors are making the move to lower cost centers overseas and moving away from the U.S. market, Mitsubishi Heavy Industries Group is moving towards it and allocating heavy capital resources domestically for a long-term growth strategy in the U.S.