TalyMaster

Rotary compressor

Greg Roper, Applications Engineer

"A brand new inspection concept combining roughness, roundness and contour on a fully automated inspection system."

Customer requirements

A recent application received by Taylor Hobson was a rotary compressor, used in the refrigeration air-conditioning industry. This manufacturer produces refrigeration compressors in high volume, typical quantities of the internal components include more than four million bearings and cranks per annum. Inspections of these components are currently completed by numerous different instruments to quantify diameter, surface finish and roundness/form.

With the production being ramped up to deliver in excess of six million bearings and cranks a new measurement technique is required to reduce the time and manual effort to inspect these components.

Inspection process

Mated Bearing & Crankshaft: Roundness, straightness and flatness <3µm, concentricity <8µm and squareness <5µm

Due to the amount of throughput, a number of machines are used to produce the bearing and cranks. It is imperative that the operators correctly associate the part with the machine it was produced on. These parts are passed to the inspectors to ensure they meet specifications. If a failure occurs it is then related back to the appropriate machine allowing the operator to make the necessary adjustments.

Some compressors are termed hermetic (hermetically sealed compressors), simply this means a sealed unit – usually a one piece welded steel case that cannot be opened for repair, if the hermetic seal fails it is simply replaced with an entire new unit, it is therefore imperative that measurements are of high accuracy and repeatable as any failures result in scrapped units at high costs for the end user.

Background – how does a refrigeration air conditioner work?

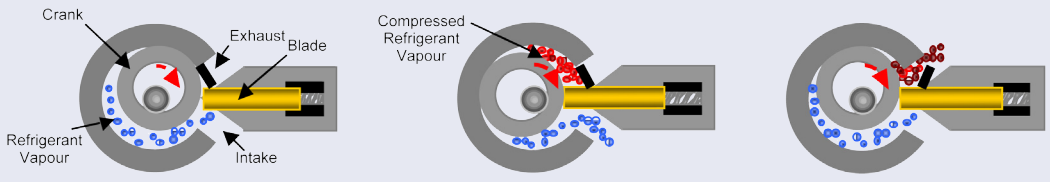
The main part of the conditioner is the rotary compressor. In a rotary compressor the refrigerant is compressed by the rotating action of a roller inside a bearing. The crank rotates eccentrically (off-centre) around a shaft so that part of the crank is always in contact with the inside wall of the bearing. A spring-mounted blade is always in contact against the crank.

The two points of contact create two sealed areas of continuously variable volume inside the bearing. At a certain point in the rotation of the crank, the intake is exposed and a quantity of refrigerant is sucked into the bearing, filling one of the sealed areas. As the crank continues to rotate the volume of the area the refrigerant occupies is reduced and the refrigerant is compressed.

When the exhaust valve is exposed, the high-pressure refrigerant forces the exhaust valve to open and the refrigerant is released. Rotary compressors are very efficient because the actions of taking in refrigerant and compressing refrigerant occur simultaneously.

The liquid runs through an expansion valve and in the process it evaporates to become cold. This cold gas runs through a set of coils that allow the gas to absorb heat and cool down the air inside the building.

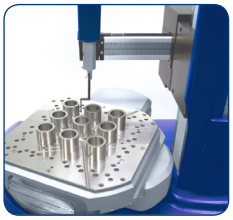
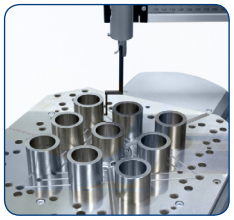
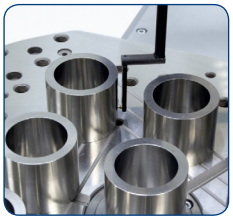
Figure 1: How refrigeration works



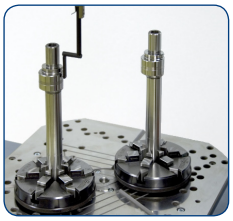
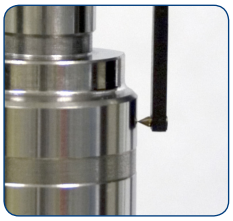
The solution – TalyMaster

TalyMaster is a brand new inspection concept combining roughness, roundness and contour on a fully automated inspection system. The instrument incorporates complete part manipulation ensuring high throughput and significantly reduced inspection costs compared to the traditional inspection methods.

The bearings were mounted directly on the XY stage (fixtures would be required in a production environment) a under program control roundness, straightness, flatness, squareness, vertical surface finish and circumferential surface finish (diameter also available) were measured and quantified.

A **critical** component for the compressor is the crank, manufactured again to a high specification this offset is essential to the operation of the compressor, this feature has not been possible to measure in the past due the large offset, however with the large movement of the XY stage, several can now be mounted at one time and this offset can now be measured and quantified, an important advantage of the TalyMaster stage.

In a production environment a simplified user interface would be used, utilising simple drop down menus allowing the operator to choose the required measurement operation, number of parts and their individual locations on the pallet. Additionally to this the interface also supports the ability to identify machine ID ready for SPC export.

Efficiency and throughput

Inspection normally consists of utilising two instruments for both roundness and surface finish, typical inspection times would be approximately fifteen minutes for roundness/form, four minutes for surface finish and one minute for diameter measurements, total twenty minutes for the combined bearing and crank.

A reduction in the number of instruments and the measurement technique means that a less skilled operator can now run the instrument.

Using the spreadsheet on the right, the total savings can be calculated and used as a method of effectively communicating the value of the TalyMaster product.

Reducing the number of instruments and the time to inspect is showing an increased inspection throughput of 45%*.

Measurement requirements (Roundness, straightness, flatness, squreness and surface finish)	**TalyMaster**	**Roundness and surface finish**
Part measurement time (mins)	11	20
Parts/shift	100	100
Attendance time per shift (hours)	0.18	33.3
No of shifts	2	2
Attendance time in year (hours)	134	24333.3
Cost per hour	40	40
Days per year	365	365
New productivty days	3025	
Total saving per annum	$967,980	
Over 10 years	$9,679,800	
Increased inspection throughput	45%	

Taylor Hobson UK
(Global Headquarters)
PO Box 36, 2 New Star Road
Leicester, LE4 9JD, England
Tel: +44 116 276 3771
taylor-hobson.sales@ametek.com

Taylor Hobson France
Tel: +33 130 68 89 30
taylor-hobson.france@ametek.com

Taylor Hobson Germany
Tel: +49 611 973040
taylor-hobson.germany@ametek.com

Taylor Hobson India
Tel: +91 80 67823200
taylor-hobson.india@ametek.com

Taylor Hobson Italy
Tel: +39 02 946 93401
taylor-hobson.italy@ametek.com

Taylor Hobson Japan
Tel: +81 36809 2406
taylor-hobson.japan@ametek.com

Taylor Hobson Korea
Tel: +82 31 888 5255
taylor-hobson.korea@ametek.com

Taylor Hobson China Beijing Office
Tel: +86 10 8526 2111
taylor-hobson.beijing@ametek.com

Taylor Hobson China Shanghai Office
Tel: +86 21 58685111-110
taylor-hobson.shanghai@ametek.com

Taylor Hobson Singapore
Tel: +65 6484 2388 Ext 120
taylor-hobson.singapore@ametek.com

Taylor Hobson USA
Tel: +1 630 621 3099
taylor-hobson.usa@ametek.com