Application Note **2 March 2016**

Reciprocating Compressor

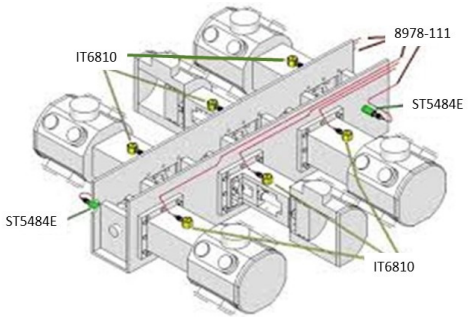
A reciprocating compressor is a positive-displacement compressor that uses pistons driven by a crankshaft to deliver gases at high pressure, sizes range from 500 to 10,000 Hp (350 to 7,500 kW). These machines can be driven by a reciprocating engine, integral reciprocating engine, or an electric motor.

Applications include oil refineries, gas pipelines, chemical plants, natural gas processing plants and refrigeration plants.The financial justification for thorough monitoring for these machines is on page three of this Application Note.

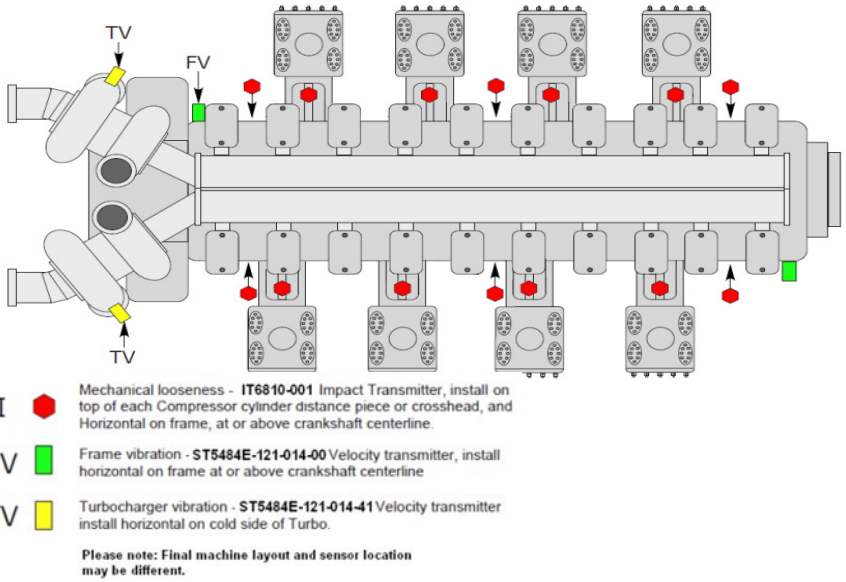
The picture on the left below shows an integral reciprocating compressor unit. The unit has the reciprocating compressor and the driving engine on the same crackshaft. The picture on the below right is a reciprocating compressor driven by a large motor. Notice how the cylinders become smaller as the gas is compressed. These machines are expensive to repair.

Typical Reciprocating Machine Configurations

Motor Driven Recip Compressor



Integral Recip Compressor and Engine



Reciprocating Compressor

Critical Situations

Given: All equipment mentioned below is connected to the Plant Control System / Information Network

Recommended Sensor Types	Locations	Monitoring System	Transducers
Impact Acceleration	On top of each compressor cylinder distance piece or crosshead, at or above crankshaft centerline (mechanical looseness).	Setpoint	SA6200A for each Cylinder
Frame Velocity	Install horizontal on frame at or above crankshaft centerline (abnormal frame vibration).	Setpoint	SV6300 (0-1 ips, 2-pin connector, Class 1 Div 2, standard 2-1500 Hz frequency range, minimum 2, at each end of compressor)
Turbocharger Velocity	Install horizontal on the cold side of the turbocharger (abnormal turbocharger vibration)	Setpoint	SV6300 (0-1 ips, 2-pin connector, Class 1 Div 2, special 50 to 500 Hz Band Pass Filter, for each turbocharger)
Proximity Probe, Rotation Marker w/ Driver	Multipulse marker for each crank shaft revolution (required for cylinder PV curves)	Setpoint	(1) MX8030 Proximity Probe, MX8031 Extension Cable, MX2033 Driver and Necessary Accessories
Proximity Probe, Rod Drop	Mounted under each piston rod (measures rider b	Setpoint	MX8030 Proximity Probe, MX8031 Extension Cable, MX2034 Transmitter and Necessary Accessories, one for each piston rod.
Temperature	On each valve cover (abnormal valve wear)	Setpoint	Metrix Special Buy, one for each valve

Minimum Sensor Types	Locations	Monitoring System	Transducers
Impact Transmitter	On top of each compressor cylinder distance piece or crosshead, at or above crankshaft centerline (mechanical looseness).	PLC/DCS	IT6810-001 (<500rpm) for each Cylinder
Frame Velocity Transmitter	Install horizontal on frame at or above crankshaft centerline (abnormal frame vibration).	PLC/DCS	ST5484E-121-014-00 (0-1 ips, 2-pin connector, Class 1 Div 2, standard 2-1500 Hz frequency range, minimum 2, at each end of compressor)
Turbocharger Velocity Transmitter (if required)	Install horizontal on the cold side of the turbocharger (abnormal turbocharger vibration)	PLC/DCS	ST5484E-121-014-41 (0-1 ips, 2-pin connector, Class 1 Div 2, special 50 to 500 Hz Band Pass Filter, for each turbocharger)

Customer Issues or Problems:

1. Critical to the Process (> 10% to 100% of process flow is through the machine).
2. Machines are expensive (> $1000 USD per kW, Ref. DOE/NETL-2002/1169).
3. Unscheduled downtime is very expensive, in certain applications it can be more expensive than the reciprocating machine itself in just a matter of days. Unscheduled Downtime = Lost Opportunity Cost.
4. Repairs due to component failure can easily be greater than $1,000,000 USD per event.

Customer Value = Cost of Unscheduled Repair + (Lost Opportunity Cost x Plant Capacity % through Machine)

1. The customer knows what this value is. Also, know that each year the customer goes without monitoring the closer they are to having an unscheduled downtime event.
2. The solution Metrix provides should provide Return on Investment (ROI) of two times the cost in less than three (3) years for avoiding just one Unscheduled Repair, for a Compounded Annual Rate of Return (CARR) of 26%.

Customer Value – Small Natural Gas Pipeline Compressor Station Example

- Natural Gas Pipeline Compressor Station – Capacity 92,000,000 cubic feet per day (2,600,000 cubic meters per day) – 100% of flow is through the reciprocating compressor.
- The margin on 1000 cubic feet of Natural Gas is $0.48 USD for sales to an Industrial Customer.
- One day of downtime results in $44,160 in Lost Opportunity Cost ($0.48 x 92,000,000/1000 x 100% = $44,160).
- Customer Value = Repair Cost + Unscheduled Downtime = + $44,160 minimum.

Note: If the pipeline capacity is 10 times larger (not uncommon for larger pipelines), the Lost Opportunity Cost is 10 times higher.