



Flexware®

Turbomachinery Engineers

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“TURBOCOMPRESSOR PERFORMANCE” Seminar Program

Chapter 1: Introduction to Compressors.

Fluid mechanics and thermodynamics. Firsts. Definition of compressor. Principles of operation. Types of compressors. Relative comparisons of various compressor types.

Chapter 2: Compression Thermodynamics.

Gas laws. Thermodynamic relations for a perfect gas. Gas properties. Gas mixtures. Real gases. BWR equation. Introduction to Gas Flex®. Use of Gas Flex to calculate gas properties. Isothermal, adiabatic and polytropic compression process. Head, work and efficiency. Mollier diagram. Performance coefficients.

Chapter 3: Aerodynamic components.

Centrifugal compressors aerodynamic components. Impeller. Diffuser. Return bend. Return channel. Pressure generation principle in a compression stage. Interstage seals. Efficiency improvements. Diaphragms. Volute. Casing. Impeller thrust. Balance piston. Balance piston seal. Compressor arrangements.

Chapter 4: Compressor characteristics.

Centrifugal compressors. The cause of the curve. Slope. Impeller blade angle. Effect on Head and Efficiency. Fluid dynamic instabilities: Stonewall and Surge. Vaned and vaneless difusers. Turbocompressor overall performance. Concept of compression sections and stages. Process versus mechanical definitions. Off-design operation. Process variables influence. Simulation with Gas Flex. RPM and gas density influence on compressor performance. Adjustable vanes influence on compressor performance.

Chapter 5: Compressor selection and Rerate.

New equipment selection. Selection procedure sequence. Example. Compressor selection using Gas Flex. Example. Rerates. Aspects to evaluate on rerate flexibility of a compressor. Example. Effect of change of gas and speed using fan laws and Gas Flex®.

Chapter 6: Compressor OEM Shop Tests.

Purpose of OEM shop tests. Hydrostatic test. Impeller overspeed test. Mechanical running test. Performance test. Witnessing a shop test.

Chapter 7: Equipment in compression systems.

Unit operation. Surge avoidance. Recycle gas cooler. Recycle gas mixing. Suction knock out drums. Gas pre-coolers. Interstage heat exchangers. Design guidelines for compressor anti-surge systems. Anti-surge control valves. Piping design for anti-surge systems. Choque avoidance.

Chapter 8: Compressor instrumentation for process control.

Flow measurement theory. Flow Meters. Orifice and flow nozzles. Venturi tubes. Pitot tube. Annubar® flow meters. Pressure and temperature measurements. Transmitters. Compressor fluid-dynamic instability strategies.

Chapter 9: Compressor operation.

System curve. Compressor curve. Operational point. Compressor operation. Compressor commissioning. Start-up procedure for steam turbine, electric motor and gas turbine driven compressor.

Chapter 10: Field performance testing.

Required information to gather in the field. Gas sampling cares. Chromatographic gas analysis. Instrumentation calibration. Conducting the test. Calculation procedures. Trend analysis. Sample calculations. Trending data using Gas Flex®. On-Line Performance monitoring.

Chapter 11: Multi-section compressors.

Special considerations when doing performance analysis of multisection compressors. Iso-cooled compressors. Examples. Compressors with economizer nozzles. Sectional performance of sideload compressors. Field data analysis.

Chapter 12: Troubleshooting performance related problems.

Sequence of analysis. Common sources of test error. Cleaning axial and centrifugal compressors. Inspection of compressors. Maintenance checklist. Troubleshooting guide. Problem solving approach.

Chapter 13: Performance Case Studies.

Refrigeration compressors. Double-Flow compressor. Air compressors. HP barrel compressor. Piping problems that affect compressor performance. How to solve them. Surge problems. Choque problems. Compressor fouling. Aerodynamic instability.

Seminar Schedule

First Day.

Flexware Presentation. Introduction to Compressors. Compression Thermodynamics. Aerodynamic Components. Compressor Characteristics.

Second Day.

Simulation of Compressor Characteristics using Gas Flex. Compressor Selection and Rerate. Compressor Shop Testing. Equipment in Compression Systems.

Third Day.

Compressor Instrumentation for Process Control. Compressor Operation. Field Performance Testing. The Use of FlexLive for On-Line Compressor Performance Monitoring. Multisection Compressors. Troubleshooting Performance Related Problems. Performance Case Studies. Compressor Modernization Strategies.

Seminar duration: 3 days.

Time schedule: From 8 to 5 with Lunch break from 12 to 1.00 and two 20 minutes coffee breaks: 1 in the morning and 1 in the afternoon.