EXPERTISE BEYOND CONTROLS

COMPRESSOR PERFORMANCE ADVISOR (CPA)

Software
Monitoring compressor performance
for the purpose of evaluating compressor productivity and
optimizing maintenance intervals is an important part of the
gas-compression industry.

It is common practice to measure inlet and discharge pressures,
temperatures, mass flow rate, and speed for compressor
performance evaluation. CPA also takes into account a variable
gas composition.
As with most mechanical devices, the performance of a running compressor slowly deteriorates from its normal healthy condition. For example, if a compressor operates at a constant compression ratio, blade fouling will decrease the flow rate and efficiency at any operational speed. CPA quantifies this degradation by comparing runtime performance to a calculated baseline model representing “healthy” compressor conditions.

CPA uses unique real-time software which can be adapted to any compressor. This model is normally built from performance data provided by the compressor original equipment manufacturer (OEM). When OEM data is not available, CPA requires on-site performance test data to build the model. This compressor performance testing should generally performed by a CCC field engineer.

All compressor performance calculations are normalized for the steady state operational mode using a BWRS real gas equation of state (EOS), in compliance with the ASME PTC-10 standard.

The main CPA functionality includes:

- Creating compressor performance mathematical models using the normalized process parameters and basic gas composition
- Calculating, monitoring and recording productivity and efficiency as runtime compressor performance parameters
- Tracking the deviation of compressor performance parameters from the modeled healthy conditions and alarming if the deviation exceeds a threshold
- Showing compressor performance deviation trends to recognize existing problems and predict developing ones
- Providing runtime transmitter verification and alarming

CPA is easily integrated with CCC human-machine interface (HMI), providing a plant operator with:

- Compressor maintenance recommendations for minimizing compressor downtime and extending compressor lifecycle
- Compressor runtime performance data for optimizing compressor efficiency by adjusting operational conditions

### Performance Monitoring

For compressor performance monitoring, CPA creates mathematical models of the compression ratio, head, efficiency, and power as functions of the flow, speed, and gas composition for the whole range of the compressor operational conditions:

- \( R_c = f(Q_s, N) \)
- \( D_p = f(Q_s, N) \)
- \( H_p = f(Q_s, N) \) — optional
- \( J = f(Q_s, N) \) — optional

The model curves are built for healthy compressor conditions using OEM or performance test data.

An operator can see measured parameters together with calculated parameters on the CPA monitoring screen.

Using the following runtime data from a control system, CPA calculates operating points that represent the actual compression ratio, volumetric flow in suction, speed, polytrophic head, efficiency, and compression power:

- Flow measurement at suction or discharge
- Suction and discharge pressures and temperatures
- Rotation speed
- Gas composition

The CPA monitoring screen displays the real-time performance values and bar graphs, indicating their deviations against the modeled healthy conditions.

If the process permits, an operator can optimize compressor operation by adjusting the flow or pressure set point that moves the CPA operating point to maximum compressor efficiency.
Performance Degradation

The compressor performance deterioration trends are displayed on the CPA performance degradation screen. An operator can see the historical deviation of the compressor Hp, Rc, power, and efficiency from the healthy conditions. CPA will predict the development of deterioration based on the historical performance degradation rate. The predicted compressor deterioration is shown as a dotted line on the performance degradation screen to help an operator make compressor maintenance decisions.

Alarms will be generated if:

- Compressor performance degradation exceeds the configured threshold
- Predicted performance degradation exceeds the configured threshold

Compressor Performance Test

Sometimes compressor performance OEM data is not available or actual compressor performance significantly deviates from the OEM data. In both cases, a performance test is required to collect performance data and build a compressor model for healthy conditions. It is recommended that a qualified CCC engineer run the performance test after compressor maintenance is completed.

Compressor Map Invariant to Gas Composition

Some high-technology processes deal with variable gas compositions when the gas compressibility periodically changes. CPA uses gas composition data updated by an operator for calculating actual compressor performance.

CPA generates performance curves for a compressor map and dynamically recalculates the curves to reflect the current gas composition or changing suction conditions.
Transmitter Verification

CPA analyzes real-time data from controller (Ps, Pd, Ts, Td and N) for transmitter verification. The following alarms are provided in case the real-time parameter relations do not match the values calculated by the model:

- Transmitter overestimate Ps or understating Pd
- Transmitter overestimate Pd or understating Ps
- Transmitter overestimate Ts or understating Td
- Transmitter overestimate Td or understating Ts

Gas Compositions Supported in CPA

9. Helium 18. Methyl Chloride (Chloromethane)

Field-Proven Operation

CPA incorporates compressor modeling that was developed and fine-tuned over the course of more than eight years of field operation in more than 50 CCC performance diagnostics system (PDS) installations worldwide.

CPA provides a plant operator with:

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- Compressor runtime performance data for optimizing compressor efficiency by adjusting operational conditions

Remote Operator Station

CPA provides an operator with remote compressor performance monitoring. The performance monitoring and performance degradation screens can be shown on a remote operator station connected to a CCC server.
Global experience. Global support.

Contact your local sales representative. Please visit our website:
www.cccglobal.com/offices