



MACHINERY ANALYSIS

RECIPROCATING COMPRESSOR Selection Chart for Vibration Studies

Vibration Study Component	← APPLICATION RISK →			
	Very Low	Low	Medium	High
1. Torsional	A Torsional Vibration Analysis* (TVA) is required if new driver/compressor configuration, change in operating conditions, etc.			
2. Pulsation (Acoustics)	Bottle Sizing only	Pulsation Analysis* (acoustic study of compressor piping system)		
3. Mechanical	n/a	Mechanical Review*	MNF Analysis* (frequency avoidance)	MNF + Forced Response Analysis*
4. Pipe Stress (Thermal, Piping Flexibility)	Strongly recommended (required) when coolers mounted off-skid			
5. Skid & Foundation	n/a	n/a	Skid Review	Skid Dynamic Analysis; Option: Lifting; and/or Transportation/Environmental Analysis

Recommended Options	
6. Small Bore Connections (SBC)	Evaluate SBC design and recommended changes. If SBC drawing not available, a site visit is recommended to assess stress and recommend improvements.
7. Foundation Design; or 8. Structural Dynamics	Structural Dynamic Analysis required for offshore facilities. Foundation design recommended for medium to large units mounted on piles or gravel, and for critical applications.
9. Fuel Gas Booster (Pulsation Limits)	Ensure pulsation limits from booster compressor to gas turbine meet owner/OEM specifications.
10. Station Analysis	Assess pulsation interaction between reciprocating and centrifugal compressors; and ensure pulsations in headers are properly managed.

Definition: API 618 Design Approach 3 (DA3) includes both Pulsation and Mechanical Analysis (both frequency avoidance and forced response analysis where required).

Application Risk: Refer to [BETA's downloadable Risk Rating Chart](#)

***Terms from Application Chart**

- **Torsional Vibration Analysis (TVA)** Evaluate torsional system and provide recommendations to avoid resonance and ensure torsional stress is below guideline.
- **Pulsation Analysis** Perform an acoustic simulation of the piping system and recommend a pulsation control solution. Evaluate the entire operating map, not just a few isolated conditions.
- **Mechanical Review** Basic review of piping system using standard “rules of thumb.” Does not include Finite Element (FE) modelling.
- **MNF Analysis** Using an accurate FE model, assess pulsation forces and gas forces across the relevant harmonics to avoid resonance conditions.
- **Forced Response Analysis** Using an accurate FE model and significant forces, calculate vibration and stress amplitudes. Recommend modifications where stress exceeds guideline.