

Compression Plant Design Services

压缩站设计服务

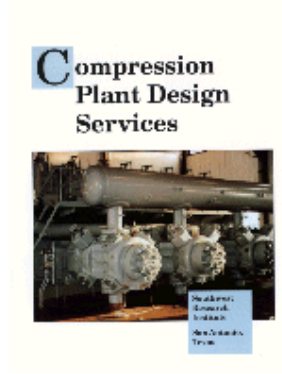
The [PCRC Design Facility*](#) at Southwest Research Institute (SwRI) is dedicated to improving and optimizing compressor, pump, and piping systems for the natural gas, petrochemical, and process industries. To prevent many operational problems before a facility is built, a planned compressor/piping system should undergo integrated design analysis, to study its:

- Acoustic response
- Mechanical dynamics
- Thermal flexibility

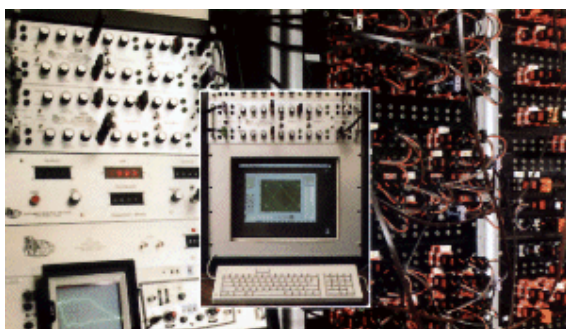
设立在美国西南研究院的管道压缩机研究中心（PCRC），美国西南研究院在该设施上，致力于改进和优化压缩机、泵和管道系统，以更好地用于天然气工业、石化工业、加工工业，在这些装置投入运行之前，预防其在操作中的问题，规划中的压缩机/管道系统应该经过综合的设计分析：

- 声音响应
- 动力学
- 热力弹性

Excessive vibration, stress, cylinder loads, thermal distortion, and pressure loss can lead to early component failure, reduced capacity, and unsatisfactory equipment efficiency. SwRI's integrated approach ensures the safe, reliable, and efficient performance of new plants and provides a powerful troubleshooting and problem-solving capability for existing plants. Institute engineers have completed in excess of 10,000 plant design and problem-solving projects over the more than 50 years the design facility has been in operation.



过度的振动、应力、汽缸负荷、热力分布、压损等，都会导致过早的零部件失效、排量的下降和无法令人满意的设备效率，美国西南研究院的综合方法确保了新装置安全、可靠及高效的性能，同时可为现有装置提供强大的故障诊断和解决问题的能力。美国西南研究院工程师已经完成了超过 10000 套装置的设计和解决问题的能力项目，在实际工作中拥有超过五十余年的装置设计经验。



Design facility simulations use analog and/or time and frequency domain numerical techniques.

使用时间或是和频率对比领域的数字技术进行设计装置的模拟。

Originally designed for reciprocating compressors, the facility's capabilities have been expanded to include reciprocating and centrifugal pumps, centrifugal compressors, and foundation design and analysis. An industry-driven research and development effort continually upgrades the facility's technologies and capabilities. The SwRI goal is to provide clients with the most comprehensive, cost-effective, and timely design and analysis services.

用于早期往复式压缩机的设计，装置的能力已经扩展到了往复泵及离心泵、离心压缩机及其基础的设计和分析，工业应用驱动着研究和开发的努力，并不断地推动装置的技术和能力的升级，美国西南研究院的目标是为客户提供综合的、高效的、及时的设计和分析服务。

SwRI begins the design process with client discussions and interaction to identify the problem, define the system, and establish cost-effective design options. This definition process is necessary to ensure that client needs are fully understood before a project is initiated. To achieve project continuity and desired results, face-to-face

meetings or teleconferences are often conducted at project startup to review drawing and available data.

美国西南研究院通过与客户进行讨论和交流，确定问题、限定系统，然后开始设计过程。这个过程的限定是必要的，能够确保在项目开展之时，满足和全面理解用户的需求，完成项目的进展和预期的结果，面对面的会议和电话交流，更有助于项目的启动并重温图纸及数据的有效

The Institute recommends a concurrent engineering approach, addressing all three analytical and design aspects of the system. Through generally interactive, the design modules can be performed singly or in any combination.

美国西南研究院推荐一种协同一致的工程方法，推崇所有的三种分析和设计的方面。经过全面的交流，设计模型能够单独完成或者联合完成。

The concurrent engineering approach provides many benefits, including:

- Improved compressor, piping, and metering performance
- Elimination of harmful pulsation effects
- Reduced operating and maintenance costs
- Improved system operability and reliability
- Validated pipe support and clamp design and placement
- Optimized pulsation bottle sizing
- Minimal static and dynamic system pressure losses

协同一致的设计步骤提供了很多的好处，包括：

- 改进压缩机、管道和流量计的性能
- 消除了有害的脉冲作用
- 减少了运行和维护的费用
- 改进系统的操作性及可靠性
- 验证管道支撑及夹持设计及其所在位置

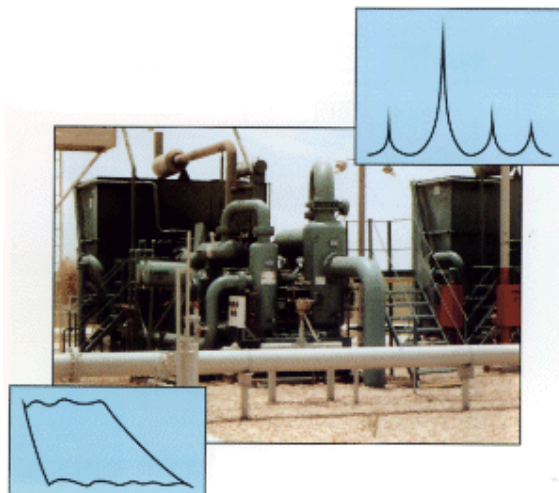
- 优化脉冲罐的设计
- 静态及动态下系统压力损失的最小化

Acoustical Design

Engineers use acoustical modeling to predict and eliminate operationally undesirable or structurally damaging pulsations resulting from interactions between fluids and machinery. Using analog or time and frequency domain numerical techniques, SwRI engineers model gas dynamics in complex systems to instantaneously define pressure and flow variation at any point in the system. Designs are developed to comply with applicable criteria, such as API 618, or with client specifications.

声音脉冲设计

工程师使用声音模型预测和消除机器设备运行过程中所不期望的结构伤害，而这正是由流体和设备相互作用下产生的脉冲所引起的，使用时间或是频率对比领域的数字技术，美国西南研究院工程师在复杂系统中模拟天然气的流态，以确定瞬间系统中任一部位的的压力和流体振动，设计的开发遵守相应的准则，如 API 618 或者用户设定的规范。



For acoustical design analysis, SwRI typically provides spectral analysis of pulsation waveforms for the piping system as well as a compressor cylinder pressure-volume diagram.

对于声音设计分析，美国西南研究院特别提供光谱的脉冲波形的分析技术，用于管道系统和压缩机气缸的压力-容积

的诊断。

To avoid poor performance or excessive dynamic loads on the compressor and piping system, acoustical design recommendations typically detail:

- Piping sizes and lengths
- Compressor cylinder bottle size and length
- Compressor cylinder bottle internal dimensions
- Acoustic filter details

为避免压缩机和管道系统性能的不足或过度的动态负荷 ,声音的脉冲设计推荐以下代表性的细节 :

- 管道尺寸和长度
- 压缩机气缸尺寸及长度
- 压缩机气缸内壁尺寸
- 声音屏蔽的细节

Acoustical analysis provides data on:

- Pulsation (pressure, flow) variations
- Acoustical shaking forces
- Compressor cylinder performance
- Pressure drop
- Compressor rod load

在以下方面提供声音脉冲的分析 :

- 脉冲 (压力、流动) 变量
- 声音脉冲摆动
- 压缩机气缸的性能

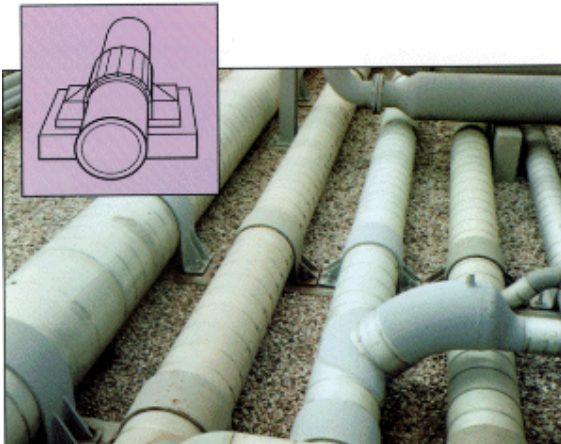
- 压力降
- 压缩机连杆负荷

Mechanical Design

SwRI uses mechanical modeling techniques to eliminate excessive vibration and dynamic stress caused by mechanical and pulsation-induced shaking forces. Natural frequencies and mode shapes are calculated to predict vibration amplitudes and dynamic stresses on compressor cylinders and pipes exposed to shaking forces. Using the model, engineers design the piping system and its restraints to ensure system safety and reliability.

力学设计

美国西南研究院使用力学仿真技术消除由力学和脉冲引起的振动力导致的过度振动和过度动应力，自然频率和模型形状的计算用于预测承受振动力的压缩机气缸和管道振动的幅度和动应力的大小。使用该模型，设计管道系统及其夹持以确保系统的安全性和可靠性。



The Institute applies piping support and restraint technology to correct mechanical problems in piping systems.

研究院应用管道支撑和定位装置校正管道系统中的力学问题。

Typical mechanical design recommendations detail:

- Piping configurations
- Piping support types and locations
- Compressor cylinder bottle and piping supports and locations
- Compressor cylinder supports
- Vessel and gas cooler structural supports
- Piping branch connections

有代表性的力学设计推荐的细节：

- 管道布局
- 管道支撑的形状和位置
- 压缩机气缸及管道支撑和位置
- 压缩机气缸的支撑
- 容器及冷却器结构的支撑
- 管道支线的连接

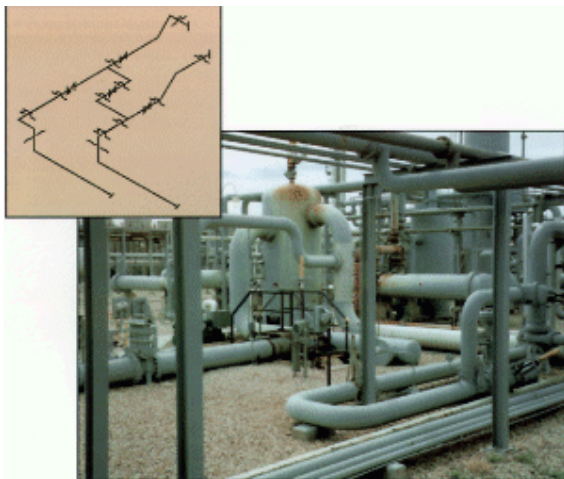
Thermal Design

Institute engineers model piping systems and major system components -- such as cross-head guides, support structures, filter bottles, coolers, and separators -- to determine static stress from thermal expansion, pressure, and weight. Piping configurations, diameters, restraints, and branch connections are modified to reduce stress to within specifications. Engineers also determine the forces and movements on major system components such as compressors, coolers, and vessels to meet client or code criteria. Recommended system modifications are input into the acoustical and mechanical models to ensure that new system parameters meet performance criteria in these areas.

热力设计

美国西南研究院工程师模拟管道系统和主要的系统部件——例如十字接头、支撑结构、过滤罐、冷却器及分离器——确定来自热力膨胀、压力和重量引起的

静态应力。更改管道结构、直径、定位及支线连接方式，就可以减少应力值在规范的要求之内，工程师同样确定主要的系统部件——如压缩机、冷却器、容器等系统的零部件。将被推荐系统的更改值输入声音脉冲及力学模型中，以确保新系统的参数能够满足这方面的性能标准。



This diagram shows piping configurations and restraint locations used in a system modeling .

使用系统热力弹性仿真，图中显示了管道结构及箍管的位置。

A thermal design typically includes:

- Piping stress calculations per applicable code
- Recommended modifications to the piping and restraint systems
- Restraint loads
- Loads on equipment

典型的热力设计包括：

- 对可应用的标准进行管道应力的计算
- 对管道和定位系统的推荐更改方式
- 管箍负荷
- 设备承受的负荷

Additional information can be collected on piping such as displacements, forces, and moments.

也可以收集更多的管道信息，如位移、外力。

Prediction Capabilities and System Optimization

Analog and digital acoustical simulations predict pulsation frequencies and amplitudes. To predict how pulsation affects cylinder performance, engineers analyze pressure-volume diagram cards, compressor valves, flow, horsepower, and efficiency. Steady-state and dynamic pressure losses through the system components are also predicted.

排量预测和系统优化

对比和数字脉冲仿真预测脉冲的频率和幅度，预测脉冲如何影响气缸的性能，工程师分析压力-容积诊断卡，分析压缩机阀门、流动、功率、效率等。同样预测经过系统零部件的稳态及动态压力损失。

SwRI optimized systems by adjusting:

- Piping diameter, length, sizes, and layouts
- Pulsation bottle size, design, and placement
- Compressor valve parameters
- Piping support type and location

通过调整以下参数，用以优化系统：

- 管道直径、长度、尺寸及布局
- 脉冲罐尺寸、设计及位置
- 压缩机阀门参数
- 管道支撑的类型和位置



SwRI routinely offers short courses on the control of pulsation in compressors, pumps, and piping systems.

美国西南研究院提供短期课程，内容包括压缩机、泵、管道系统的脉冲控制

Design services include validating designs before construction and correcting problems in existing plants. By minimizing static and dynamic pressure losses, fuel costs are reduced and throughput is increased. The Institute demonstrates compliance with applicable codes for piping stresses, deflections, pulsation, and pressure losses.

在设备开工之前和验证现有压缩站的问题中，设计服务包括设计确认。通过静态和动态压损，燃料费用的降低，生产量的提高，美国西南研究院证明管道应力、偏差、脉冲和压损相一致。

Additional Services

In addition to compression plant design services, SwRI offers a variety of related services, such as:

- Field engineering for reciprocating and rotating machinery
 - Signature analysis
 - Performance evaluation
 - Fluid pulsation analysis
 - Piping vibration
 - Foundations and structures
 - Plant noise
- Compressor diagnostics
- Transient flow analysis
- Critical speed analysis
- Electronic monitoring and control of machinery
- Engine design and monitoring
- Emissions measurement and control

Services have numerous applications, including:

- Carbon dioxide systems
- Chemical plants
- Fossil power plants
- Gas compressor stations
- Gas metering facilities
- LDPE plants
- Liquid pump stations
- Manufacturing facilities
- Mining operations
- Nuclear power plants
- Offshore installations
- Oil and gas fields
- Petrochemical plants
- Pipeline facilities
- Processing plants
- Pulp and paper mills
- Refineries
- Ships and tankers
- Slurry systems
- Steel mills

更多的服务

除了压缩站设计服务，美国西南研究院提供了多种相关的服务，如下：

- 为往复式和旋转机械提供现场工程服务
 - 信号分析
 - 性能评价
 - 流体脉冲分析
 - 管道振动
 - 基础及结构
 - 现场噪声
- 压缩机诊断

- 瞬态流量分析
- 临界速度分析
- 及其的电子监控和控制
- 发动机设计和监控
- 排放测量和监控

我们的服务应用在很多的行业中，包括：

- 二氧化碳系统
- 化工厂
- 化石燃料工厂
- 天然气压缩站
- 天然气计量设施
- 低密度聚乙烯工厂
- 液压泵站
- 生产设施
- 采矿业
- 核电站
- 滩海装置
- 石油及天然气田
- 石化厂
- 管道设施
- 处理厂

- 纸浆和造纸业
- 炼油厂
- 船舶和油轮
- 泥浆系统
- 钢厂

*The Pipeline and Compressor Research Council (PCRC) of the Southern Gas Association is a nonprofit organization with more than 60 members, representing natural gas transmission and production, petrochemical, and equipment companies. SwRI and PCRC have collaborated since 1953 to meet the needs of the gas pipeline, refining, and process industries.

*南方天然气协会的管道和压缩机研究委员会(PCRC)是一个非赢利的组织，成员超过 60 个，代表天然气运输、生产、石化及设备公司，美国西南研究院与美国管道和压缩机研究委员会自 1953 年共同协作，满足天然气管道、炼油厂、处理工业的需求。

更多的信息请您联络美国西南研究院北京代表处李金武，北京朝阳区东三环北路 8 号亮马河大厦 1 座 1303 室，电子邮箱：jinwu.li@swri.org 手机：13911774667，电话：010-65906391-805, 传真：010-65906392