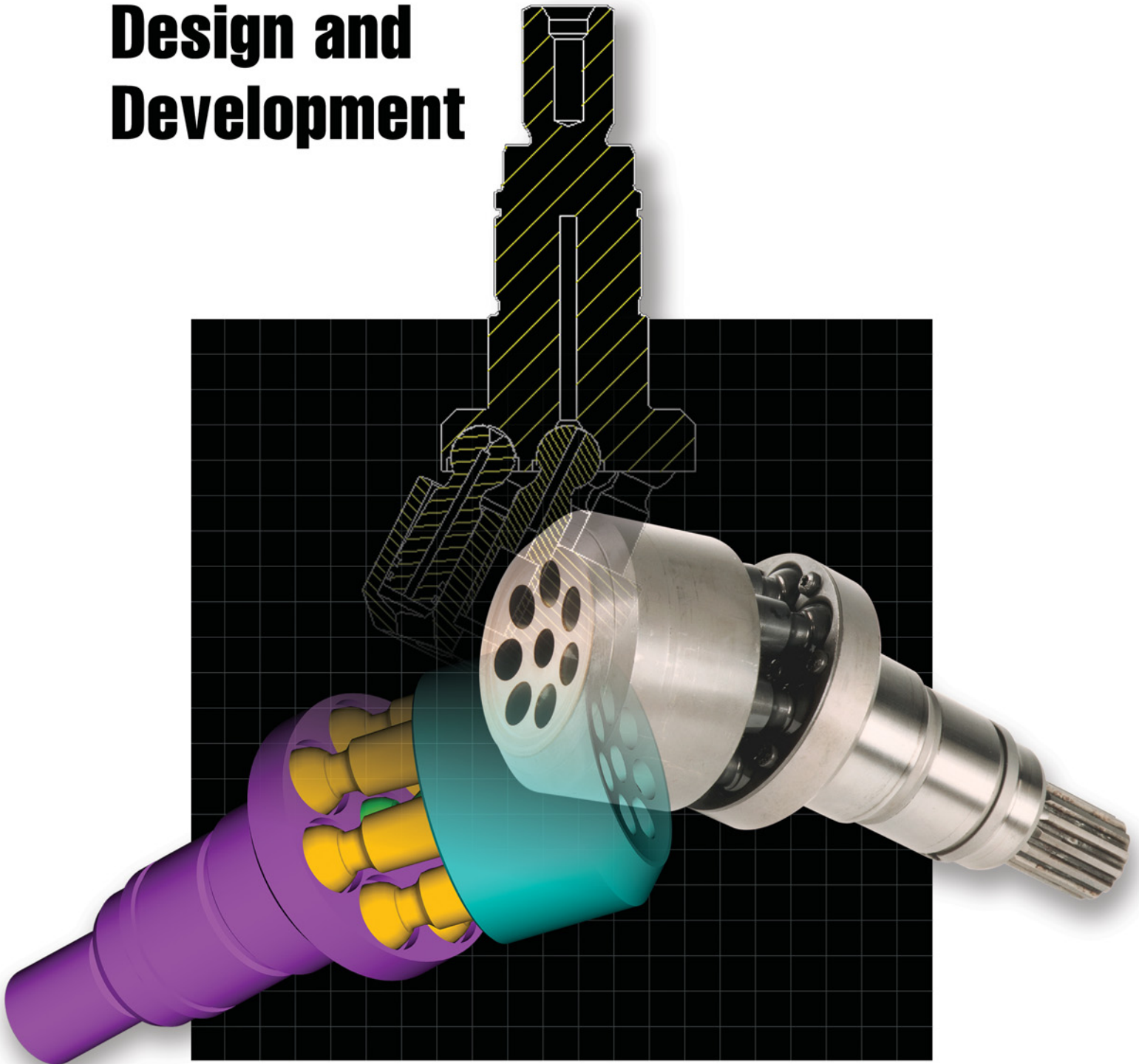


# Hydraulic Systems

**Design and  
Development**



**Southwest Research Institute®**

**San Antonio, Texas**

**H**ydraulic fluid power systems produce unparalleled levels of power with tremendous flexibility and minimal size and weight requirements. As a multidisciplinary research and development organization, Southwest Research Institute® (SwRI®) is uniquely qualified to aid clients in developing specialty hydraulic systems, while identifying and resolving pneumatic and hydraulic fluid power problems.

SwRI's Engine and Vehicle Research Division has achieved certification to ISO 9001, ensuring compliance with stringent quality control procedures in design, development, and testing.

During the initial development or improvement of hydraulic systems, SwRI engineers refine existing designs and develop innovative solutions to problems. Using commercial and SwRI-developed software, Institute engineers perform three-dimensional solid modeling, structural analysis, and performance simulation for hydraulic components and systems, including:

- Pumps and motors
- Valves
- Accumulators
- Actuators
- Integrated systems

## Design

In designing a new hydraulic system, engineers and designers perform a wide spectrum of services, ranging from generating innovative concepts to preparing final machining and assembly drawings. SwRI provides products such as:

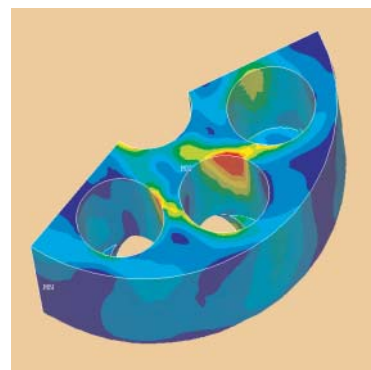
- Requirement and specifications development
- Concept formulation and brainstorming
- Three-dimensional solid modeling of components and assemblies
- Design for manufacture and assembly (DFMA)
- Realistic design illustration for enhanced concept review and product promotion
- Concept evaluation and trade studies
- Detailed component machining drawings
- Assembly drawings, including exploded assembly views

## Analysis

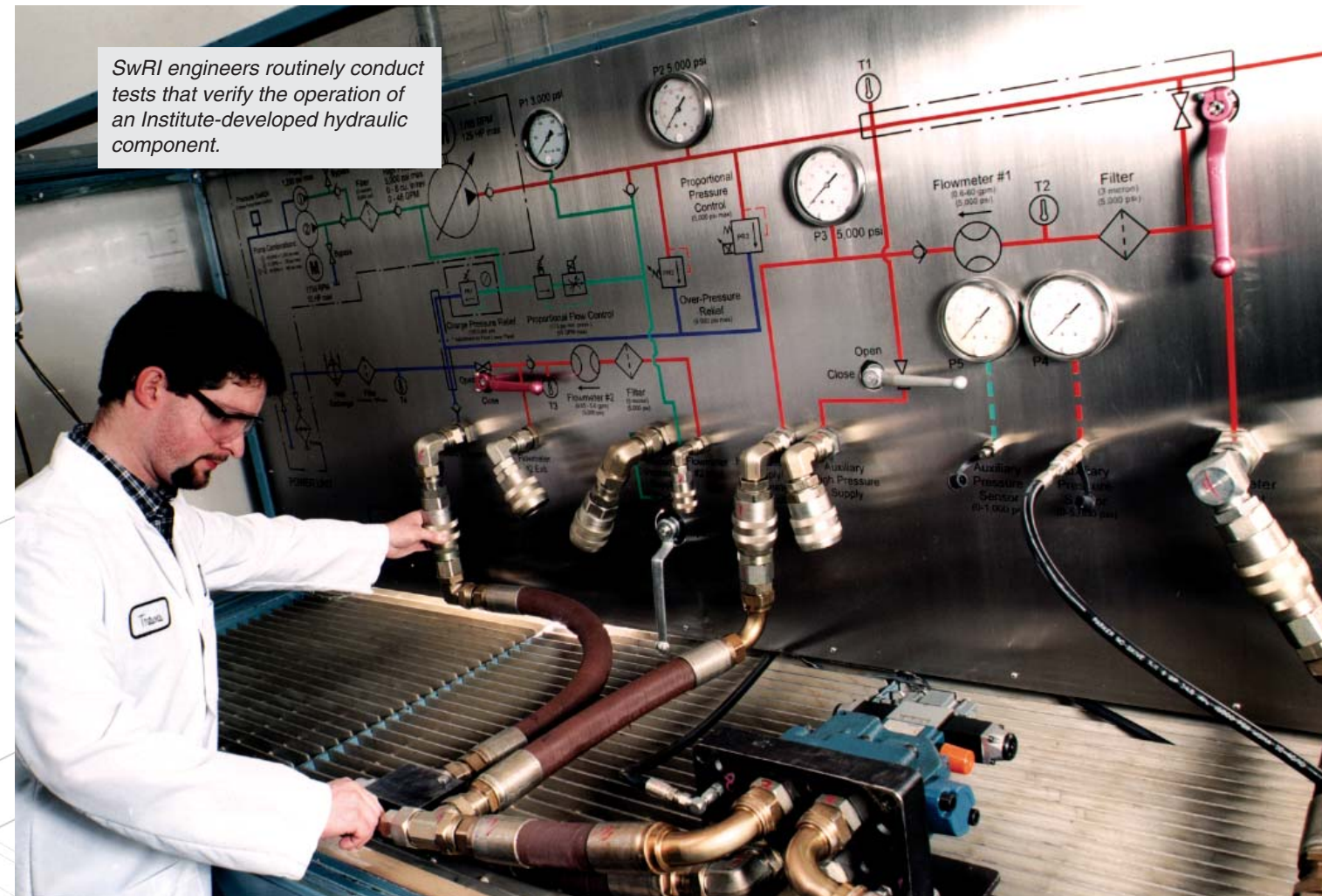
Institute engineers analyze the operating characteristics of hydraulic components and systems to improve existing designs or develop and optimize new ones. Analytical techniques include:

- Linear and nonlinear finite element analysis
- Structural optimization
- Thermodynamic evaluation
- Computational fluid dynamics
- Kinematic analysis
- Modal evaluation
- Torsional analysis
- Tribological analysis
- System dynamics

*Institute engineers use finite element analyses to evaluate the stresses and deflections in a pump cylinder barrel, enabling the component's power density to be increased substantially.*



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SwRI engineers routinely conduct tests that verify the operation of an Institute-developed hydraulic component.

## Optimization

SwRI engineers optimize hydraulic system designs to meet performance requirements, minimize wear, and increase service life. In improving a hydraulic system, engineers consider numerous criteria, including:

- Production cost
- Weight
- Flow capacity
- Torque and pressure "ripple"
- Noise
- Size
- Efficiency
- Durability
- Safety

Institute engineers evaluate a number of factors to determine their impact on system performance. These factors include:

- Cavitation
- Fluid compressibility
- Leakage
- Aeration
- Permeation
- Stability
- Heat generation
- Stiction
- Windage
- Noise, vibration, and harshness (NVH)

## Fabrication

SwRI provides extensive fabrication services, using state-of-the-art equipment and facilities, rapid functional and conceptual prototyping capabilities, and proven suppliers. Institute staff routinely fabricate hydraulic component prototypes, including:

- Pumping elements
- Bladders
- Spool and poppet valves
- Pistons
- Housings
- Seals
- Hoses and lines
- Control systems
- Electrical and electronic interfaces



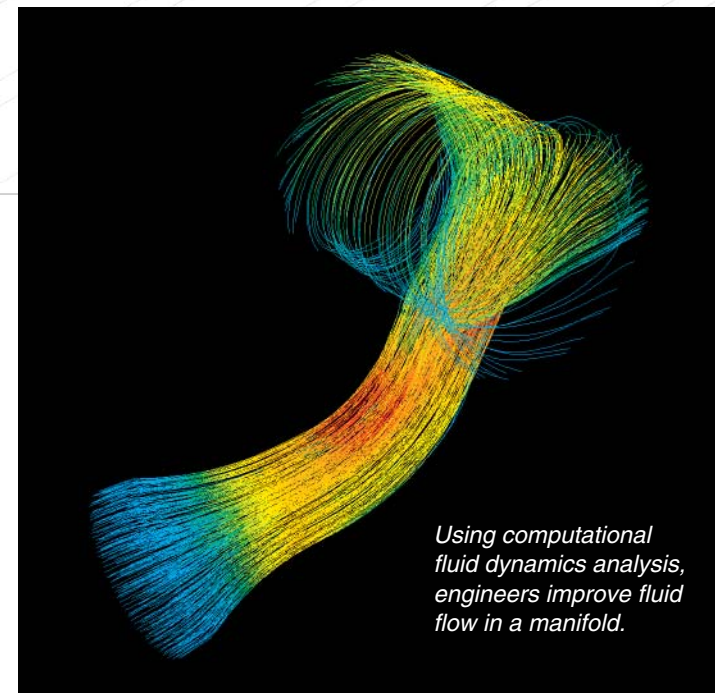
*SwRI engineers optimize the valve plate interface of a motor and pump to meet industry or client requirements for noise, stability, leakage, and durability.*

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## Testing

Using flexible and well-equipped test facilities, SwRI staff test hydraulic components and systems to verify and validate new designs and to measure existing design characteristics. SwRI evaluates a wide range of hydraulic-related characteristics, such as:

- Efficiency
- Flow loss
- Burst and proof pressure
- Durability
- Noise
- Pressure transients
- Environmental



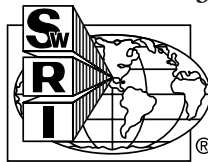
*Using computational fluid dynamics analysis, engineers improve fluid flow in a manifold.*

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*Founded in 1947, Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute's main facility, located in San Antonio, Texas, occupies 1,200 acres and provides nearly two million square feet of laboratories, test facilities, workshops, and offices for more than 2,700 employees who perform contract work for industry and government clients.*

*We welcome your inquiries.  
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**ISO 9001 Certified – Engine and Vehicle Research Division**

The Engine and Vehicle Research Division of Southwest Research Institute has achieved certification to ISO 9001, an internationally recognized quality standard.