

Engineering
technically reliable,
cost-effective
sealing solutions

InterFace
Solutions

Technically Reliable, Cost-Effective Solutions

Designing for Functional Performance

In order to specify a cost-effective, technically reliable sealing solution, an original equipment manufacturer's (OEM's) design engineer must consider multiple key technology issues.

What to consider:

Design Elements

Considerations include:

- Flange composition (steel, aluminum, iron, etc.) and geometry
- Flange-surface finishes
- Bolt spacing and quantity
- Bolt specifications

Warranty Requirements

As the global economy becomes more competitive, major automakers are offering longer warranties, including lifetime drive-train warranties. OEM engineers must know, and design for, a seal's required service life.

The Sealing Environment

Operating parameters include:

- Fluid to be sealed
- Pressure range
- Temperature range
- Continuous and peak values

Health, Safety and Environmental Considerations

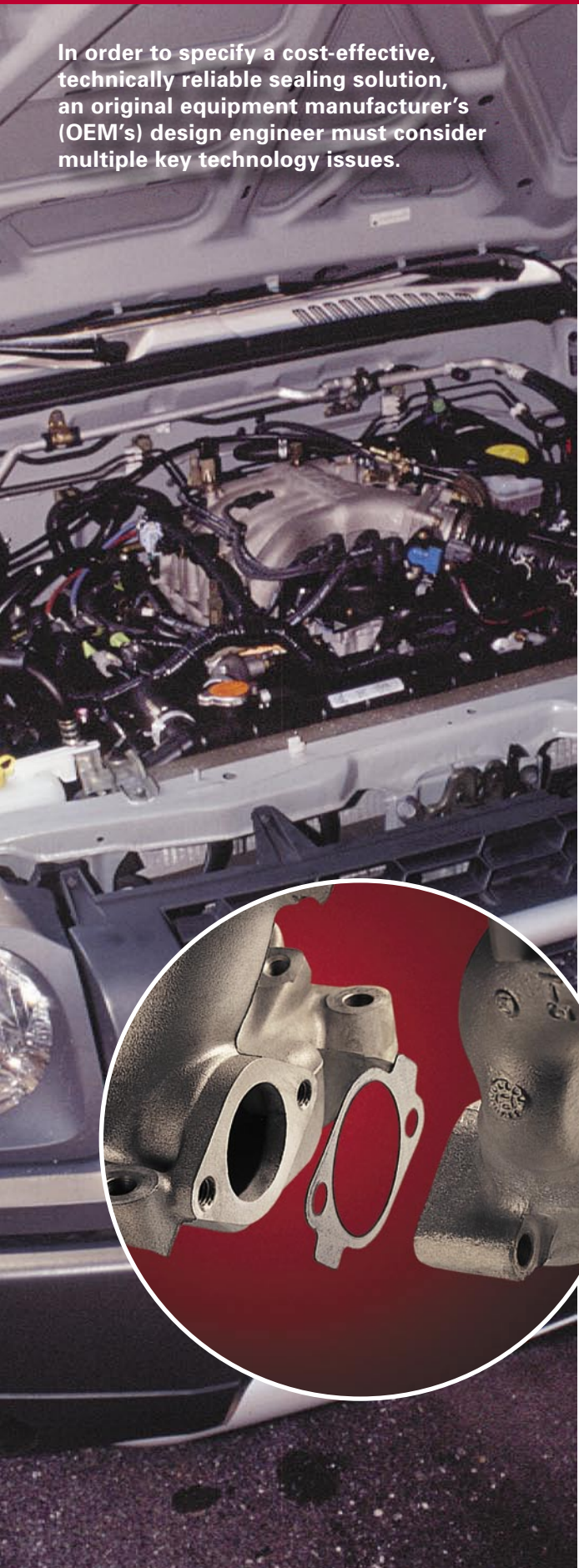
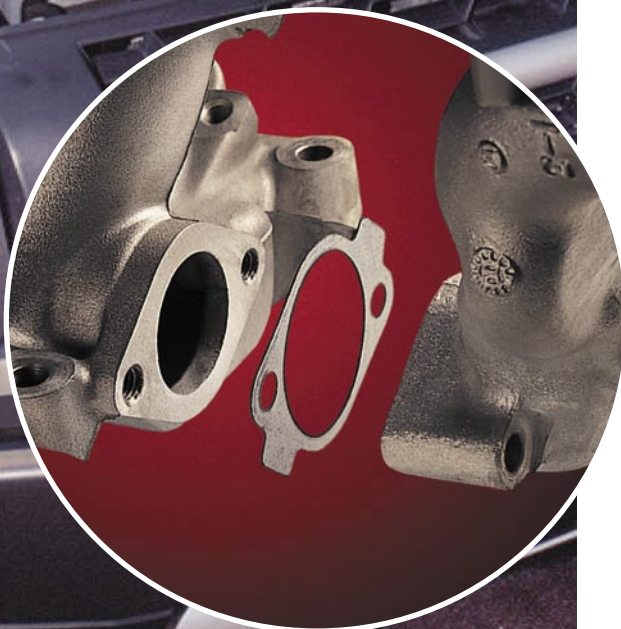
With governments becoming increasingly concerned about carcinogens and other harmful substances in the workplace and in finished products, design engineers must ensure that the gasket specified is absolutely free from asbestos, solvents and other harmful or restricted materials.

Lower Total Cost

Lowest initial cost is far from the most important concern in specifying a sealing solution. Critical cost drivers also include the variety of joints to be sealed, the spectrum of sealing environments to be addressed, the development of new, more robust gasket materials and increasingly difficult warranty challenges. The most important goal is finding the solution that will provide *long-term cost effectiveness*.

Employing Best Practices

With extended warranties and tougher environmental regulations coming into play, testing and validating a selected sealing solution is crucial to ensuring wide market acceptance across the globe.



Why:

Design Elements—Performance

The joint's design elements determine the required sealing load and gasket thickness. In addition, the design elements determine whether:

- Additional machining of flange faces will be required
- Differences in flange materials will require compensation for different coefficients of expansion
- Longer bolt spans might reduce material and/or assembly costs

Warranty Requirements—Quality

There is no substitute for satisfied customers. Premature breakdowns and subsequent warranty claims can undermine customer satisfaction and damage a manufacturer's reputation.

The Sealing Environment—Confidence

Interface Solutions' application engineers are specifically trained in the task of matching material properties with operational requirements. Using the latest analytic techniques, these experts can specify cost-effective, technically reliable solutions based on functional performance.

Health, Safety and Environmental—Reputation

An OEM can enhance its reputation as a good corporate citizen by carefully overseeing the impact its products make on the environment and by putting measures into place that help ensure the safety of its workers.

Lower Total Cost—Effectiveness

ISI takes more than price into consideration. We evaluate the overall cost effectiveness of the solution by balancing all the relevant factors that go into selecting a gasket for a specific application. The goal is technically-reliable, cost-effective sealing solutions.

Doing It Right—Every Time

Bringing reliable equipment to market is what makes and keeps original equipment manufacturers competitive. When it comes to sealing, Interface Solutions has a proven track record for doing it right the first time.

By addressing these issues and resolving them, an OEM's design engineer can help ensure successful sealing solutions.



OEM Inputs—Design Parameters and Application Inputs

At Interface Solutions our application engineers support OEMs and their Tier 1 sealing system suppliers by taking information supplied by original equipment engineers and applying it to specific sealing applications. The goal is to provide cost-effective, technically reliable sealing solutions backed by hard data and sound engineering analysis.

The process involves more than selecting a sealing material from a list of physical characteristics, e.g., density, compressibility, tensile strength and operating temperature.

ISI evaluates a material's functional performance and documents the functional properties relevant to a specific application. We work with our OEM customers and/or their Tier 1 suppliers to provide more than commodities — we offer application-specific results proven to work.

ISI uses a systems approach that allows our engineers and technicians to deliver the appropriate gasket for a specific joint's operational environment. To get the process started, an OEM needs only to provide ISI with key information such as design and sealing environment details and sourcing information. Then, working with the OEM and/or its supplier, ISI will engineer a result that meets all the functional requirements. Once the requirements are defined, ISI does the rest.

1

Design Criteria:

- Flange drawings/models
- Flange surface finish
- Bolt details:
size, torque, length, friction

2

Sealing Environment:

- Fluid and Pressure
- Temperature:
peak/continuous

3

Performance:

- Warranty
- Production air leak check

4

Corporate Requirements:

- Environmental
- Health
- Safety



Compression Modulus
Temperature Resistance

Seal
Friction C

Interface Inputs—Expertise and Material Database

The performance capabilities of ISI gasket materials are defined using the latest technologies and functional performance testing in the industry. Each material is characterized to define its performance capabilities using:

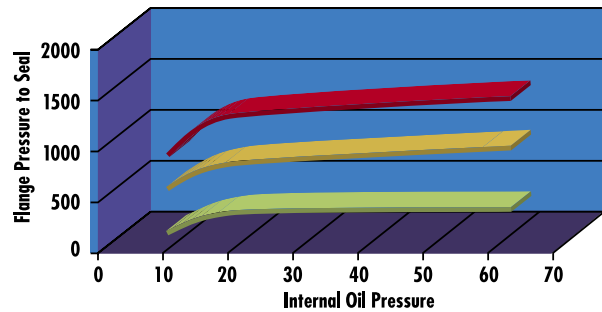
- Sealability testing — nitrogen, oil and coolant
- Compressive strength
- Resistance to friction and thermal expansion
- Poisson ratio
- Load/Compression curves
- Torque retention properties
- Chemical resistance
- Temperature resistance

ISI offers a full range of engineering services to support this process. These include gasket design, flange analysis, joint design recommendations and part-validation testing.

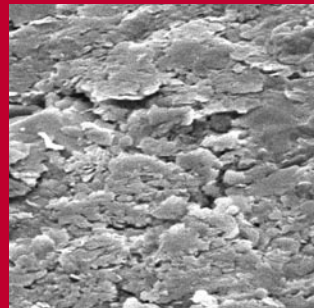
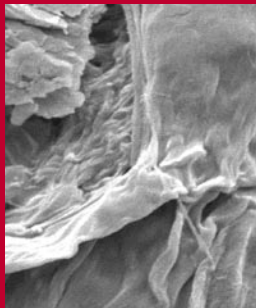
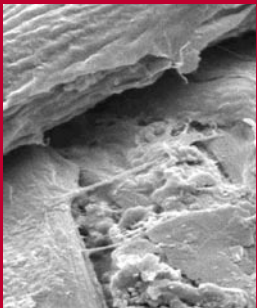
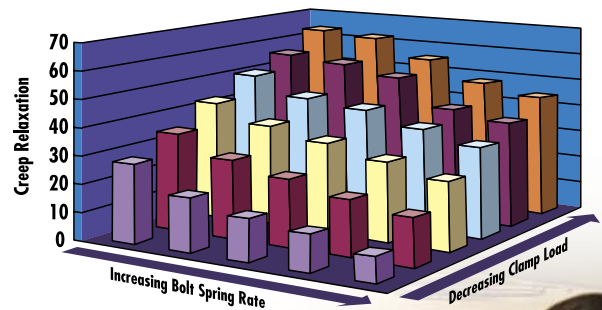
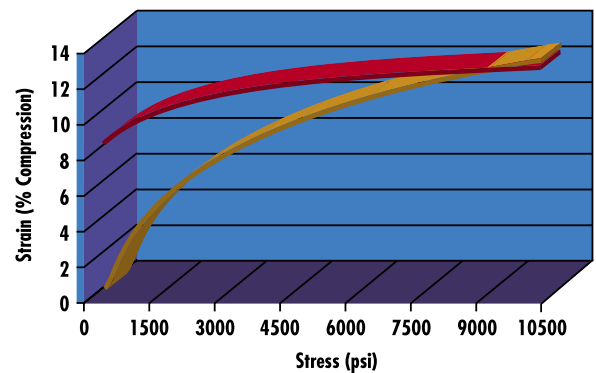
ISI capabilities include:

- Complete material property testing in accordance with ASTM and DIN standards
- Proprietary functional and property testing that produces sound predictive modeling of gasket performance
- Material selection based on computer modeling of joint parameters and material performance data
- Comprehensive part validation testing

Minimum Flange Pressure to Seal Oil



Stress/Strain Curves



Competitive Technologies

MicroPore® technology



ability vs. Stress
Coefficient

Mechanical Strength
Creep Relaxation

Chemical Compatibility
Gasket Spring Rate

Design Outputs and Design Verification

Interface Solutions takes all the initial input and performs the analysis and testing required to determine the most cost effective sealing solution that meets the customer's defined criteria. We use the latest technical tools to evaluate and predict the performance of the recommended sealing solution. We eliminate all the guesswork. There is no need for re-testing or re-design work.

3-D Solid Modeling

With OEMs using solid modeling (3-D CAD) to design engines and transmissions, ISI's engineers can now better design gaskets for those assemblies.

GMX

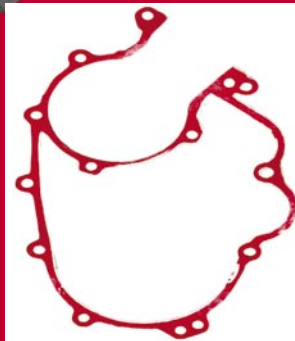
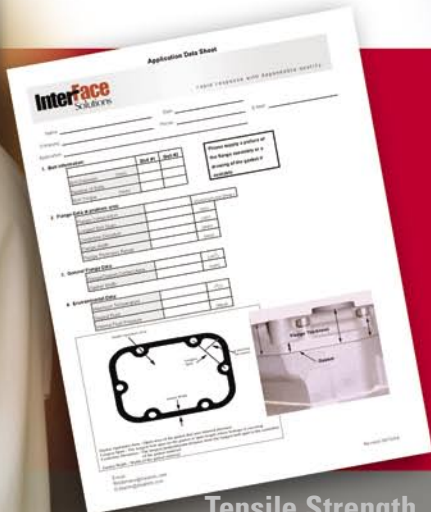
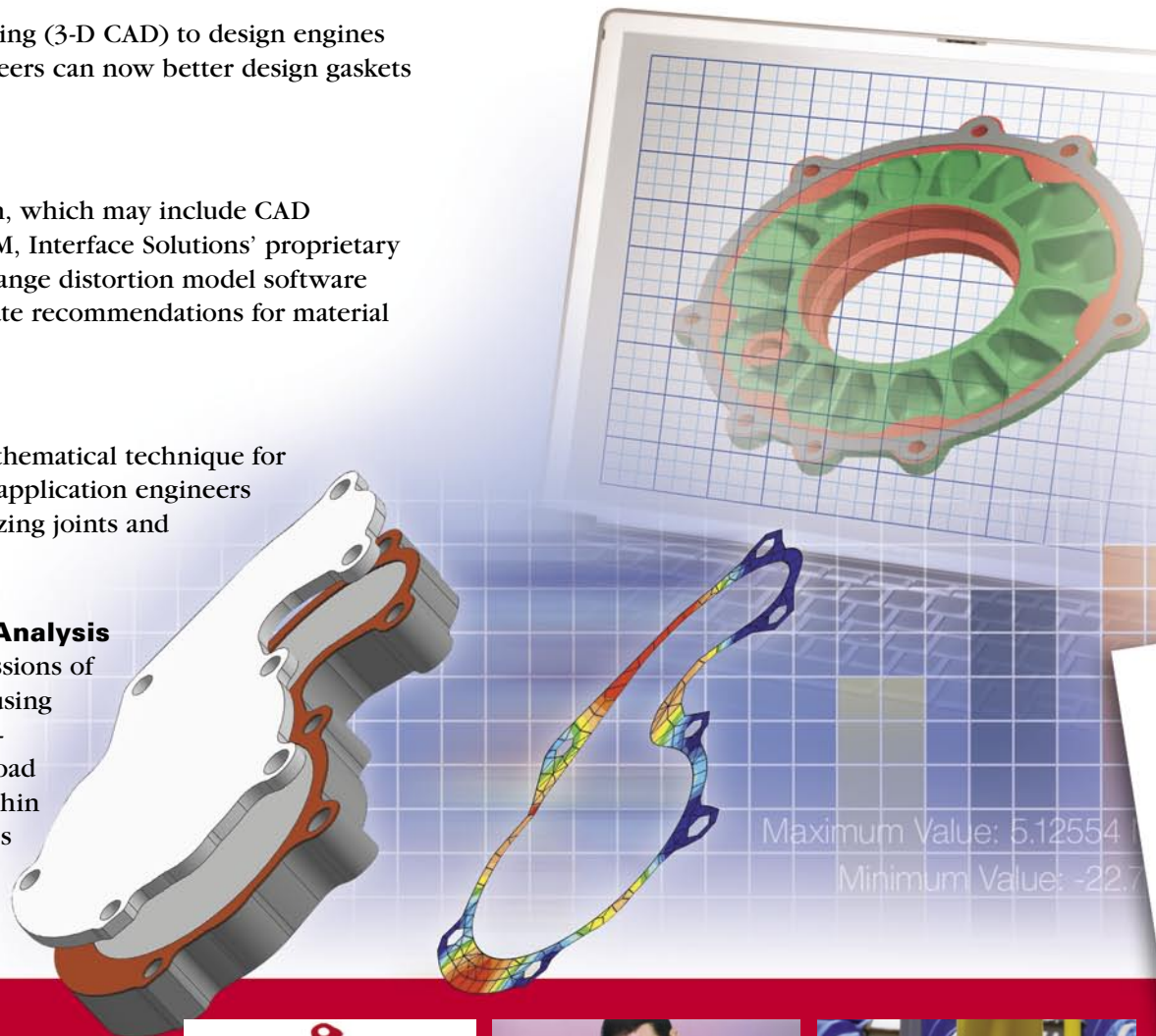
Based on detailed information, which may include CAD drawings supplied by the OEM, Interface Solutions' proprietary Gasket Material Expert and flange distortion model software provides fast, accurate recommendations for material and joint designs.

FEA

Finite Element Analysis, a mathematical technique for analyzing stress, provides ISI application engineers with powerful tools for analyzing joints and modeling sealing solutions.

Pressure-Sensitive Film Analysis

Pressure-sensitive film impressions of joints, which are performed using specially formulated pressure-sensitive paper, give a static load distribution measurement within a joint to reveal flange stresses on gaskets and other sealing challenges.



Tensile Strength
Stress-Strain Curves

Surface Conformability
Flange Composition

Load Distribution
Unrecoverable Strain

Bolt Preload
Thread Load Retention

Yield

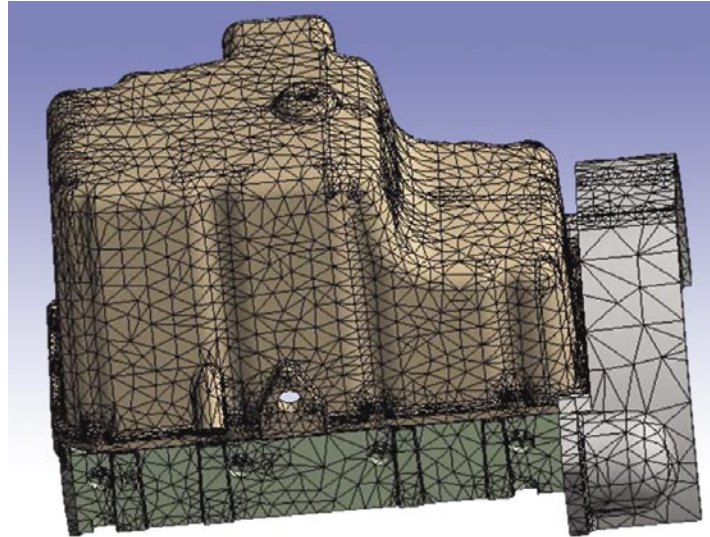
OEM—Design Validation and Production Approval

Our comprehensive testing capabilities provide for static and dynamic testing, accelerated aging, response to fluid exposure, heat, high thermal change rates, pressure pulsing, vibration, and more. The result: OEMs and suppliers have the data to prove the gasket material meets all performance specifications.

Component or laboratory tests that are used to confirm material performance include:

- Thermal cycling:
 - with high temperature/pressure fluid circulation
 - with vibration
- Nitrogen sealability
- Oil and coolant sealability
- Hot compression shearing
- Friction/shear testing
- Erosion testing
- Pressure-pulse testing
- Dynamometer testing
- Customized bench testing

Once the testing has established that the OEM's criteria have been satisfactorily met, production approval can be confirmed.



InterFace Solutions Inc. First Engine Company
Gear Housing to Block Application

InterFace Solutions Inc. First Engine Company
Gear Housing Applications
Sensor Film Analysis

Material	Gage (mm)	Min. Pressure (MPa)
MP-1F	1.2	1.0
MP-1N	1.2	1.0
MP-2N	1.2	1.0
MP-1S	1.0	1.0
MP-2S	1.0	1.0
PE-4S	1.0	1.0

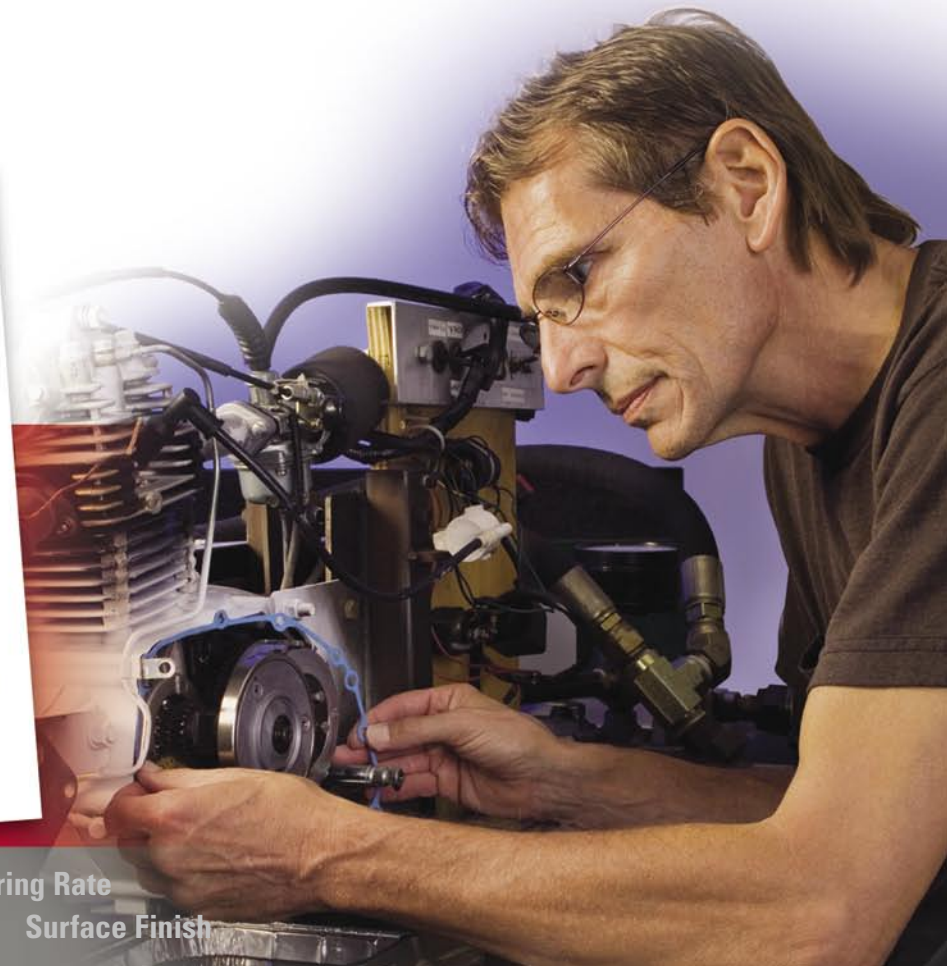
SUMMARY:
The gear housing to block application sealability at low flange load following pages and without distribution profile varies 9.5mm centerline deviation. 5mm centerline deviation exhibit an unfavorable split focus of the model. MP-1S minimum flange pressure is that would occur over time. Interface Solutions Applications assist in the verification and

Follow-up Efforts:
Testing and evaluation of gasket solution. Interface thermal cycling or other

FE Analysis

Analysis indicates these areas require Select-a-Seal to provide a durable

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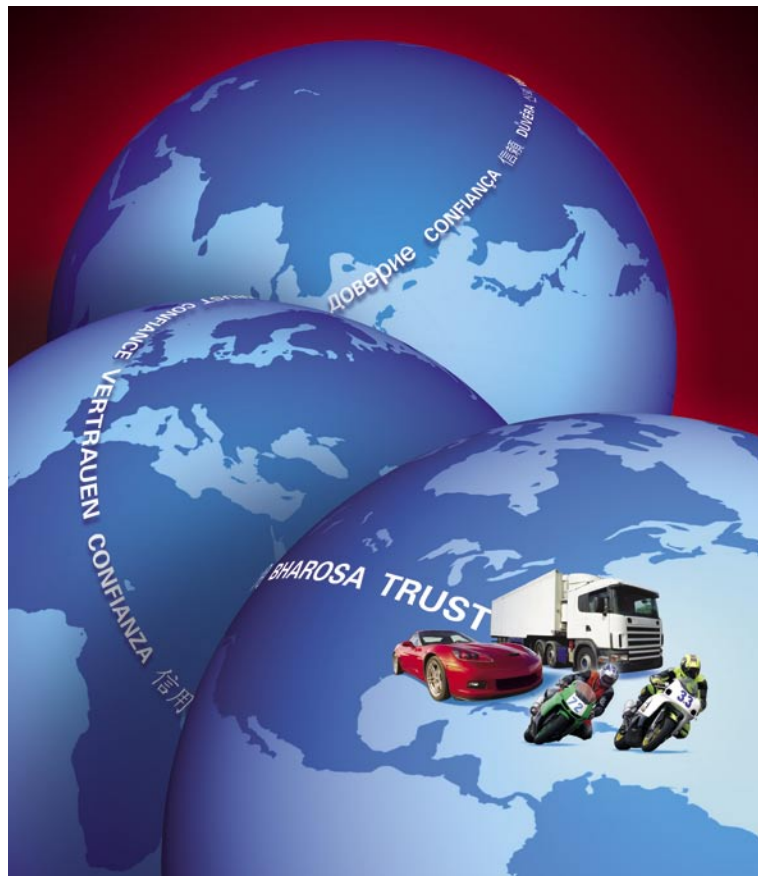


Global Support

At Interface Solutions, we understand that different market segments and localities require different products, different approaches, and different levels of technical support. With our knowledge of the global market, our broad product line, and value-added services, we are uniquely equipped to support your needs. Contact Interface Solutions today. We will work with you to provide cost-effective, technically reliable sealing solutions using your performance and application criteria.

Quality Standards

Manufacturing plants in Beaver Falls, Fulton and Hoosick Falls, NY are registered to ISO 9001, as is the Research and Development facility in Lancaster, PA. The Centerville product design and manufacturing operation and manufacturing plants in Croghan, NY and Marshalltown, IA are registered by Underwriters Laboratories, Inc. to TS 16949, the Harmonized Standard for the Automotive Supply Chain. TS 16949 is the automotive industry's most challenging standard. We view these certifications as confirmation that our quality processes are among the best in the sealing industry. Our OEM and aftermarket customers benefit from added assurance of our quality.



▲ *Interface Solutions serves businesses worldwide with quality product, engineering support, and superior customer service.*

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