Ergonomic Influences on the Use and Choice of Assembly Lubricants

Tom McGuckin – VP, Research, Quality & Safety

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Providing Assembly and Cleaning Solutions since 1923

EVOLUTION OF PARTS DESIGN

Manufacturing climate has evolved, and ergonomists are having more influence over how parts are designed and assembled due to increased awareness of worker health and safety.

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ERGONOMIC INFLUENCE

Concerns with Repetitive Assembly Tasks

- Muscle Effort Monitoring
- Hand and Arm Vibration
- Contact Pressure Measurement
- Anthropometric analyses
- Dynamic Postural Testing
- Worker Equipment and Instrument Design

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ERGONOMIC IMPLEMENTATION

Collaborative Effort for the Design of Piston and Bores

How to achieve the maximum reduction of friction

- Force Gauge Instruments
- Measurable Results
- Actual Parts, when possible

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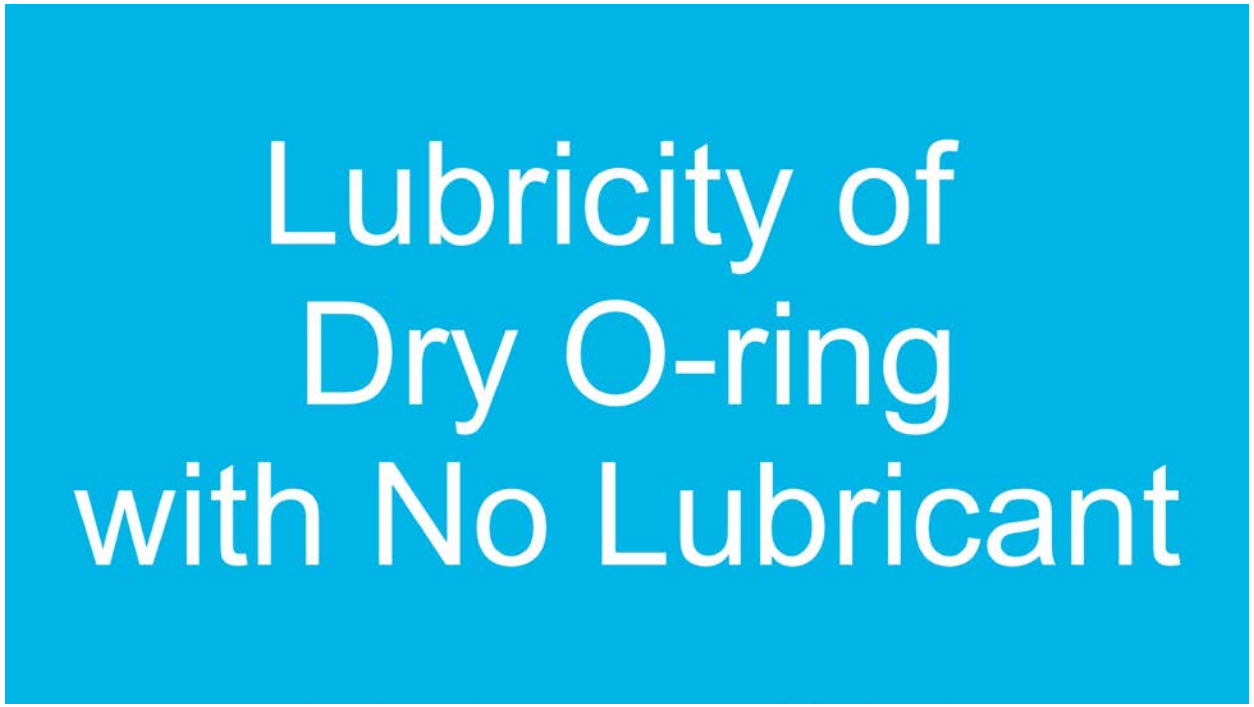
TEMPORARY RUBBER ASSEMBLY LUBRICANTS



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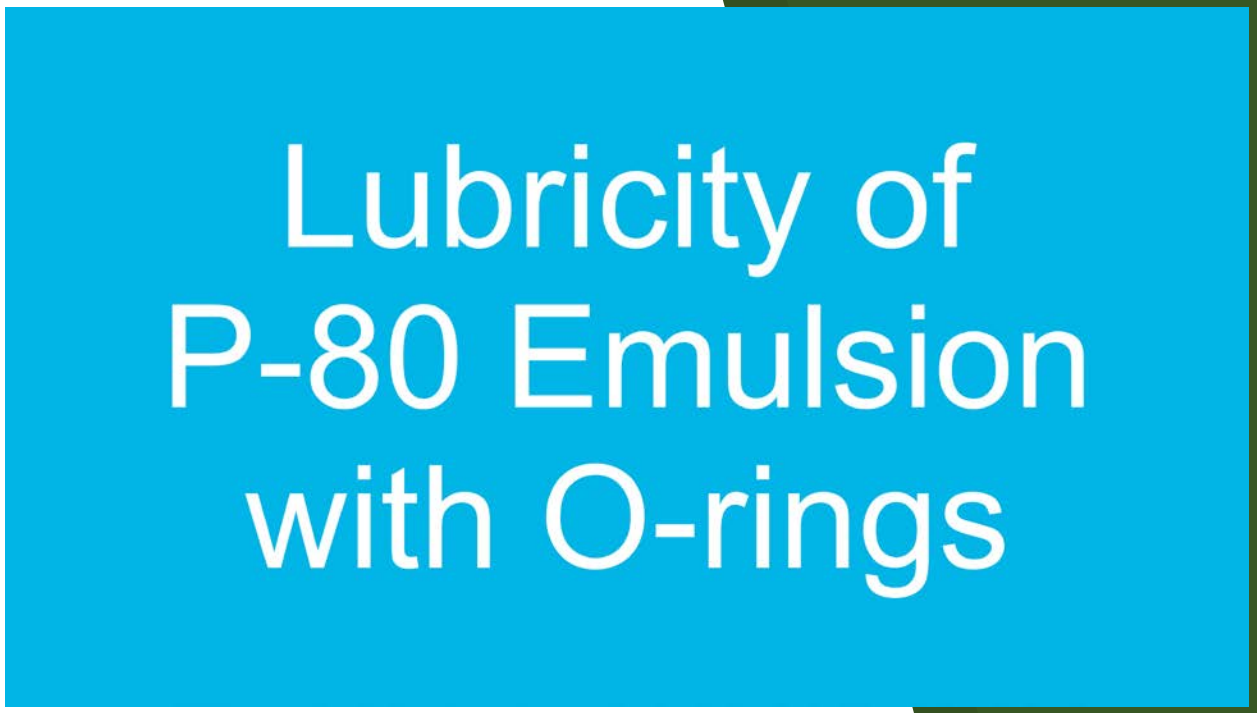

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CASE STUDY

Collaborative Effort for the Design of Piston and Bores

Automotive Manufacturer

- Process Engineers
- Design Engineers
- Safety/Quality Managers
- Ergonomic Engineers
- Lubricant Engineers

O-Ring Manufacturer

- Design Engineers

Lubricant Manufacturer

- Chemists
- Regulatory Personnel

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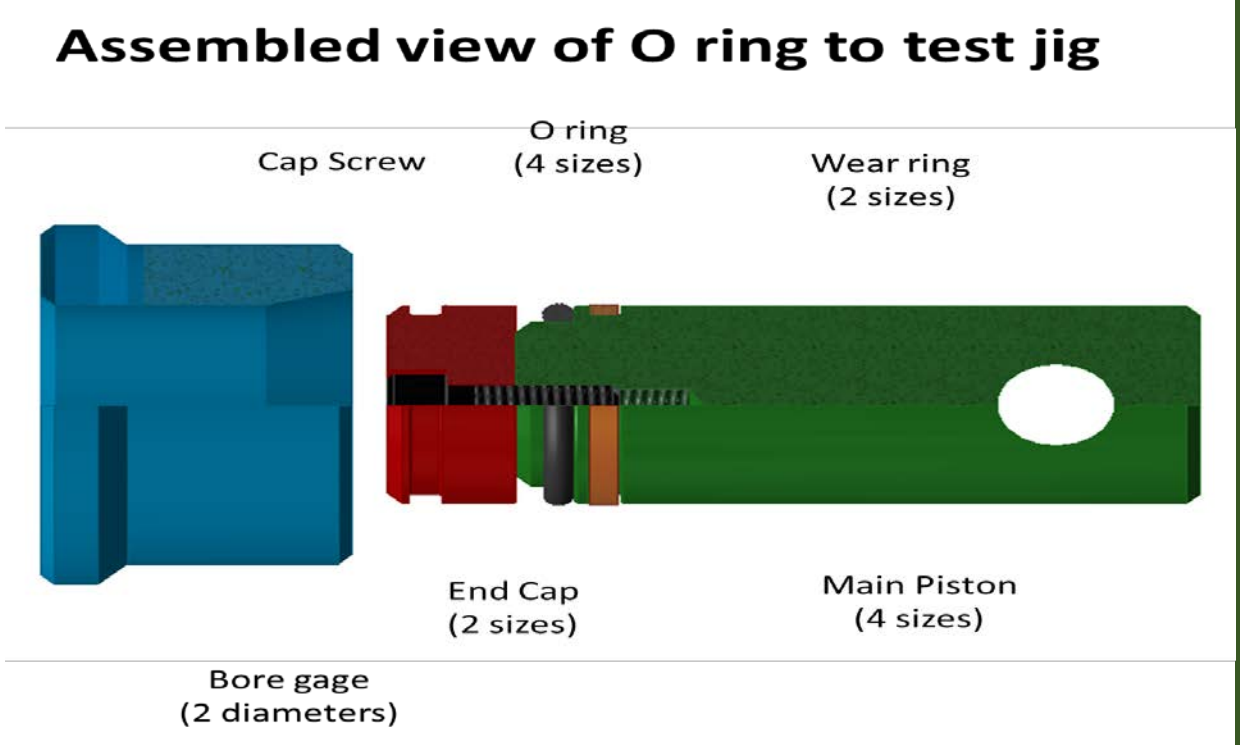
CUSTOMER-SPECIFIC APPLICATION TESTING

Customer Testing/Efficacy

Effort for Design of Pistons and Bores for Specific Car Model

- Automotive Manufacturer
- O-Ring Manufacturer
- International Products – Lubricant Manufacturer



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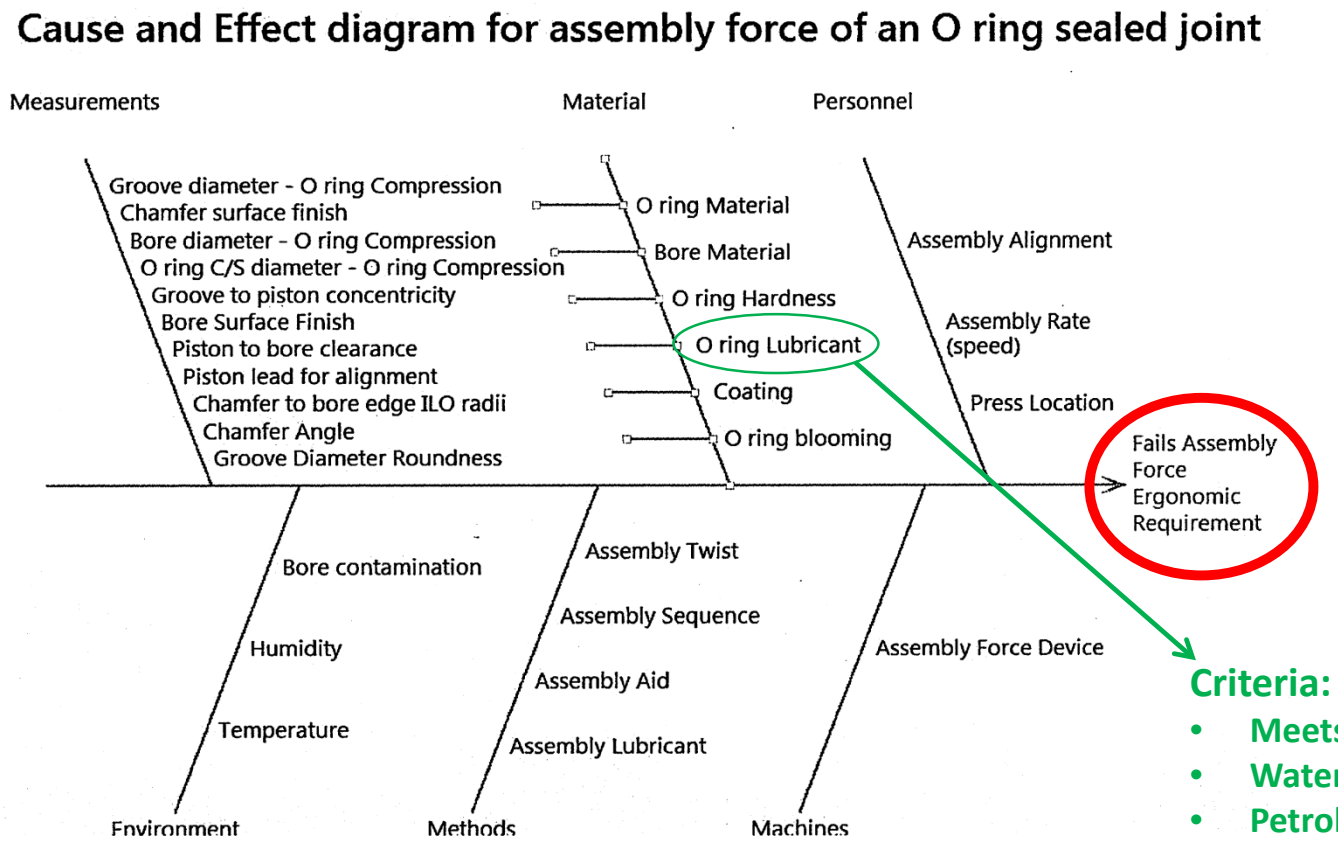
COORDINATION OF EFFORTS

Work with Lubricant, Quality, Safety, Ergonomic and Design Engineers



Criteria:

- **Meets Ergonomic Target**
- **Water-based**
- **Petroleum Free**
- **Temporary**
- **Biodegradable**
- **Non-hazardous**
- **REACH Compliant**

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COLLABORATION

Ergonomic Engineer

1. Friction and Effort Reduction
2. Production Rates
3. Health & Safety Hazards
4. Quality & Consistency

Design Engineer

1. Design Tolerance
2. Part Breakage
3. Production Rates
4. Dry Time
5. Material Compatibility

Lubricant Engineer

1. Toxicity Approval
2. Regulatory Compliance
3. Performance
4. Costs

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COMMONLY USED ASSEMBLY LUBRICANTS

- Petroleum Distillates and Silicone –
  Permanent lubrication, compatibility issues.
- Soap and Water –
  Quality and consistency problems, may slip when rewet, corrosion.
- Solvents –
  Health and safety issues. Efficacy problems.
- New Ester-Based Technology –
  Effective, temporary and biodegradable.

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ERGONOMIC CRITERIA: < 110 NEWTONS

Testing: Lubrication Design of Experiment Data

StdOrder	RunOrder	Lubrication	Bore Diameter	Operator	Peak Assembly Force (N)
22	1	P-80 Emulsion	31.72	Two	51.2
14	2	P-80 Emulsion	31.72	Two	49.4
2	3	Dry	31.72	Two	294.6
10	4	Dry	31.72	Two	304
17	5	Dry	31.72	One	264.6
18	6	Dry	31.72	Two	294.8
24	7	P-80 Emulsion	38.07	Two	53.4
8	8	P-80 Emulsion	38.07	Two	54.6
12	9	Dry	38.07	Two	303.2
3	10	Dry	38.07	One	225.4
9	11	Dry	31.72	One	330.8
16	12	P-80 Emulsion	38.07	Two	53.4
19	13	Dry	38.07	One	270.4
21	14	P-80 Emulsion	31.72	One	45.4
13	15	P-80 Emulsion	31.72	One	45.6
5	16	P-80 Emulsion	31.72	One	45.4
4	17	Dry	38.07	Two	295.4
20	18	Dry	38.07	Two	285.4
6	19	P-80 Emulsion	31.72	Two	49
11	20	Dry	38.07	One	276.4
23	21	P-80 Emulsion	38.07	One	54.2
1	22	Dry	31.72	One	348.2
7	23	P-80 Emulsion	38.07	One	51.8
15	24	P-80 Emulsion	38.07	One	55.6

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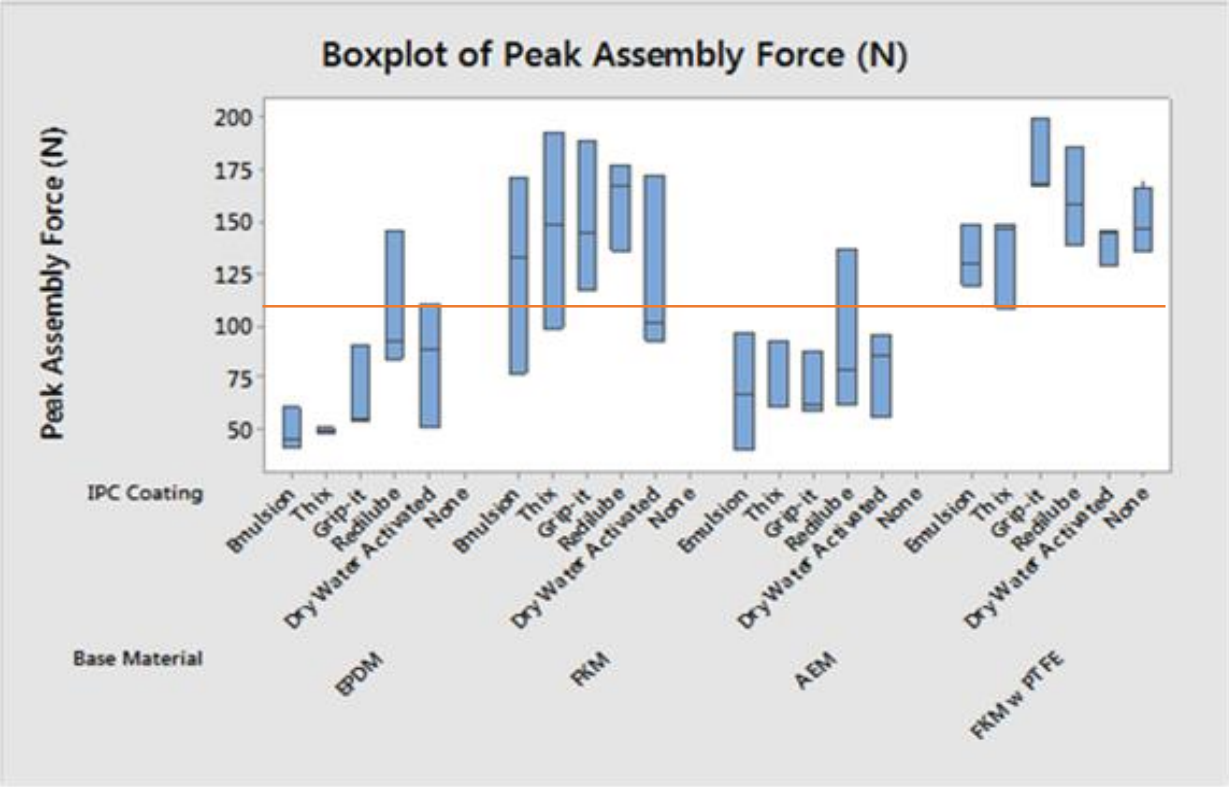
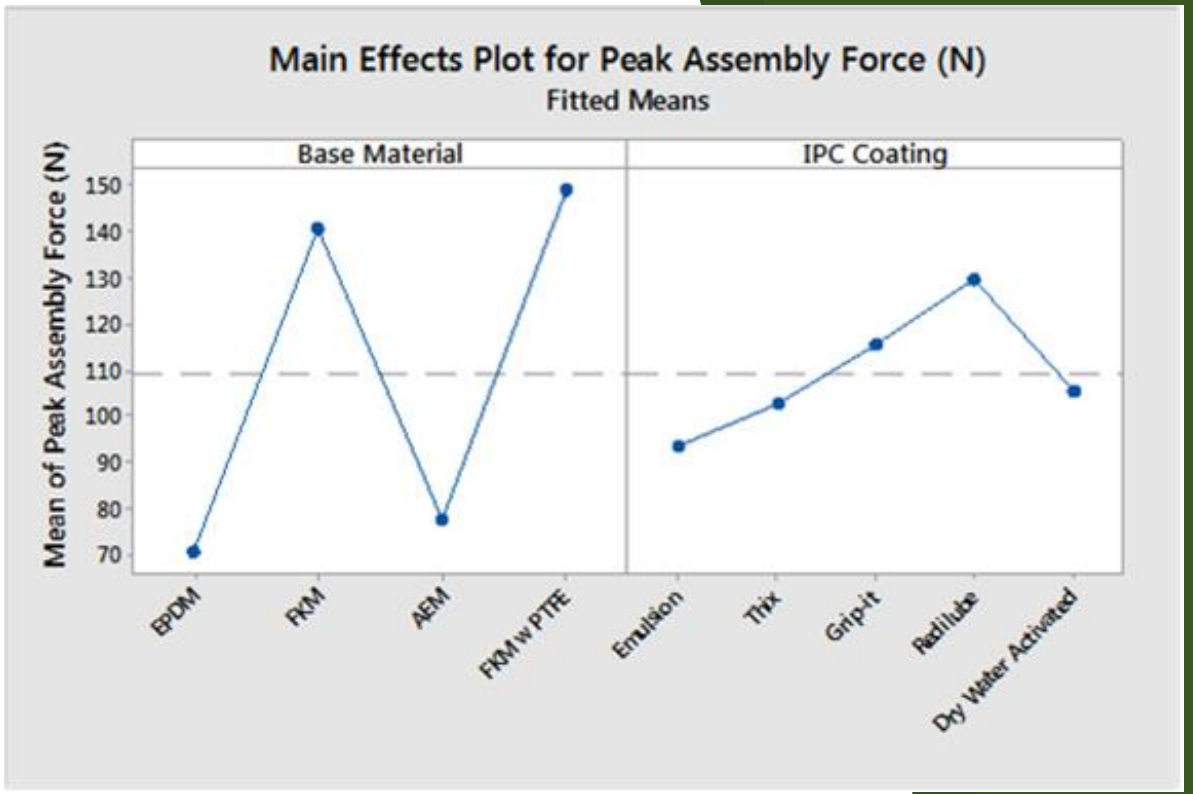
ERGONOMIC ASSESMENT

Testing: Lubrication Design of Experiment Results





Ergonomic Target: < 110 Newtons

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ERGONOMIC ASSESMENT

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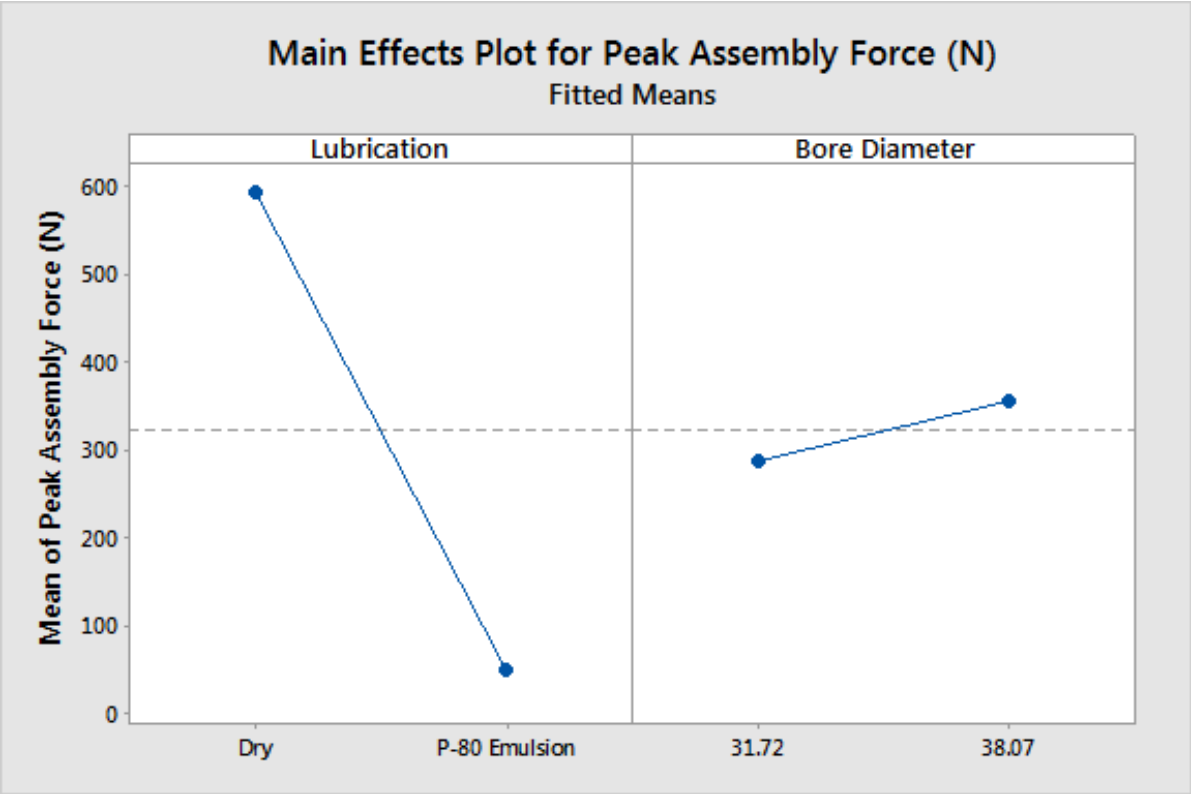

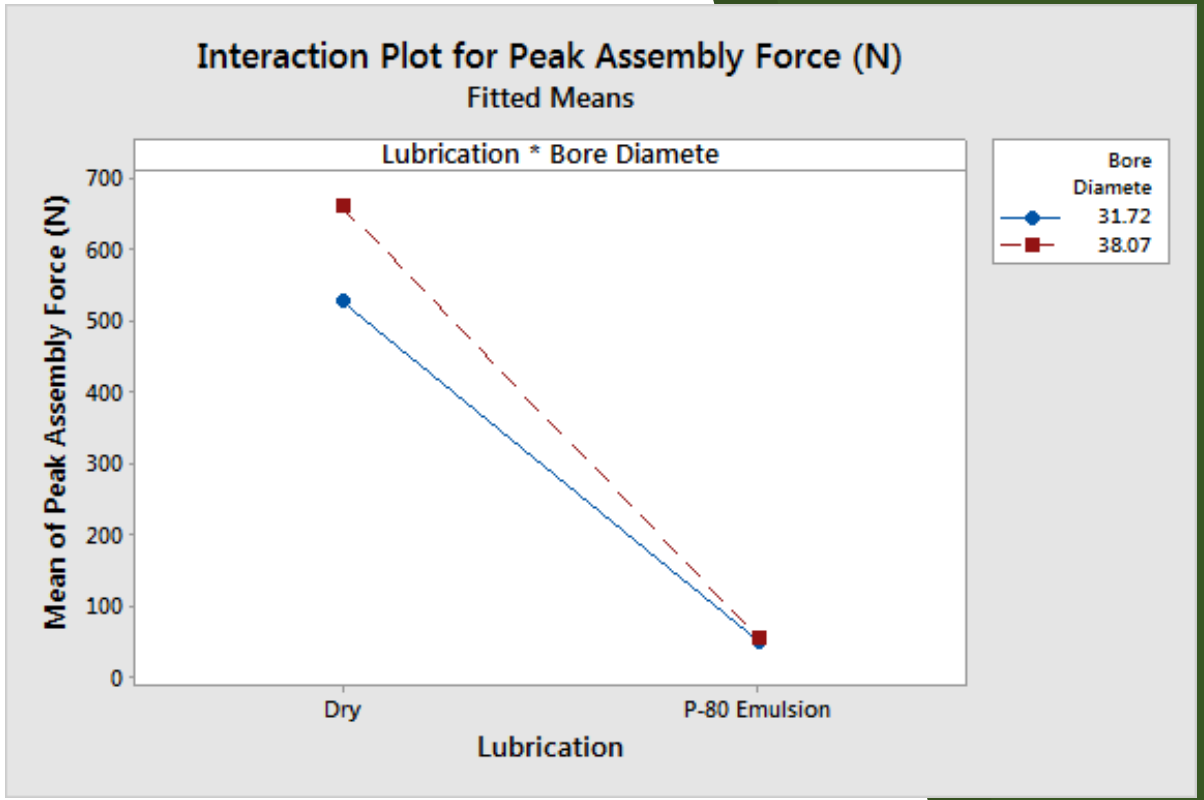

Ergonomic Target: < 110 Newtons

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PROGRESSION TO ERGONOMIC SPECIFICATIONS

Temporary Rubber Assembly Lubricants Role in Part Design

PROGRESSION

Lubricant choice based on convenience. An afterthought.

- Soap and water
- Alcohol
- Gasoline
- Motor Oil
- Vaseline
- Silicone spray

Lubricant choice based on technical specifications.

- ASTM D471: Rubber Property – Effect of Liquids
- ASTM D543: Resistance of Plastics to Chemicals
- ASTM D573: Rubber Deterioration
- ASTM D4048: Copper Corrosion of Lubricating Greases
- Etc., etc., etc.,

Lubricant is part of the design process to meet overriding ergonomic targets.

- Bore Assembly – 110 Newtons
- Fuel Line Assembly – 50 Newtons
- Sump Motor assembly – 225 Newtons

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ADDITIONAL ENVIRONMENTAL AND HEALTH CONSIDERATIONS

Available Tests:

- RoHS Materials
- Conflict Materials
- SVHC
- Solvents

In-house supplier tests vs. Third Party Independent testing.

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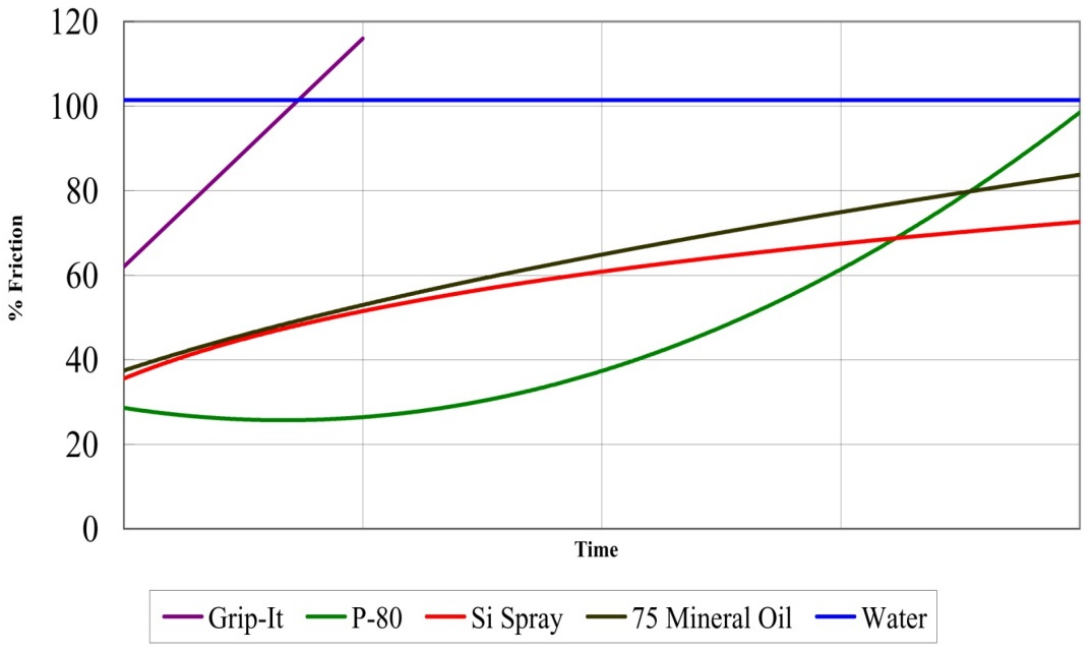
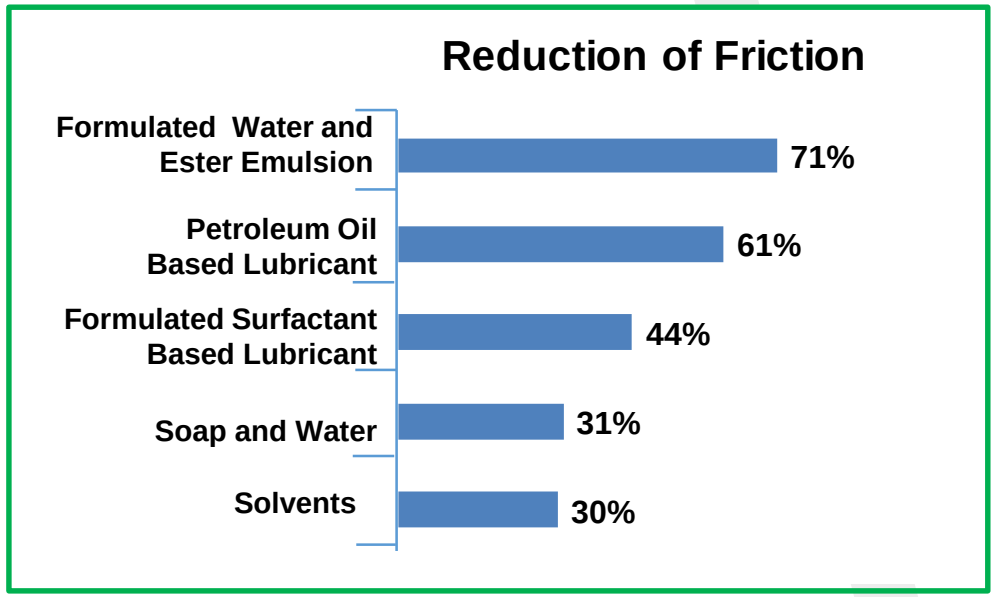
EFFICIENCY OF LUBRICANTS

Lubrication Over Time



Comparison of Lubricants



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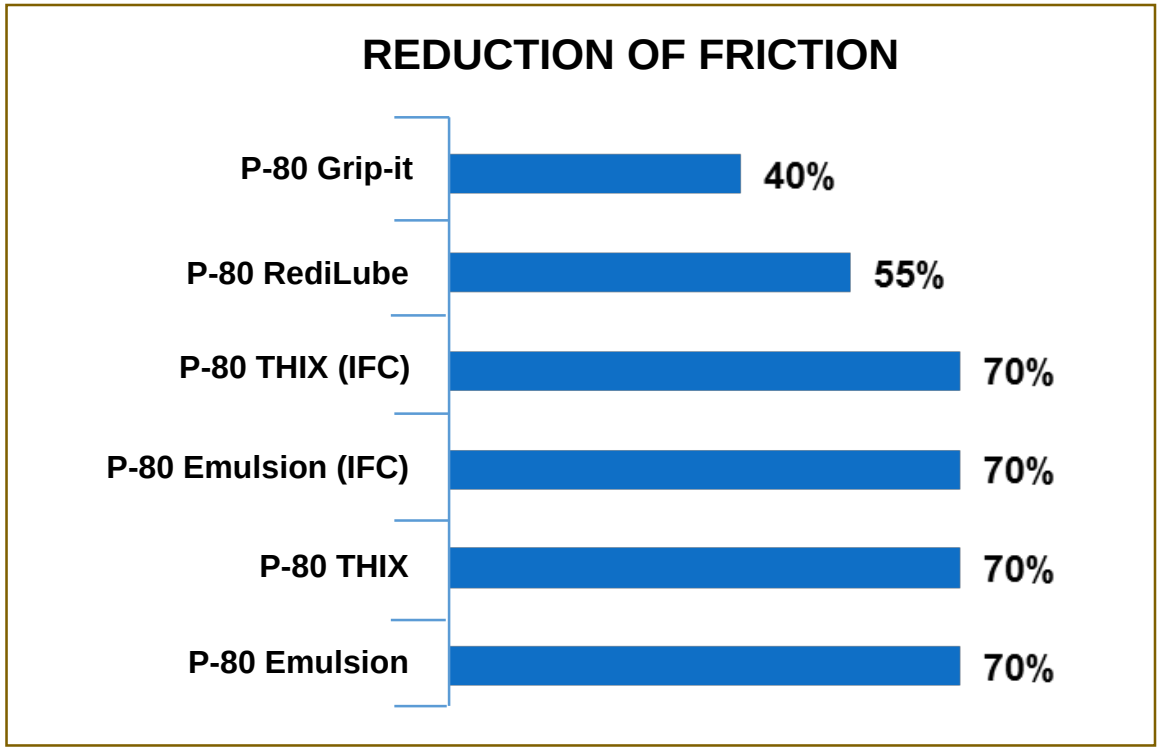
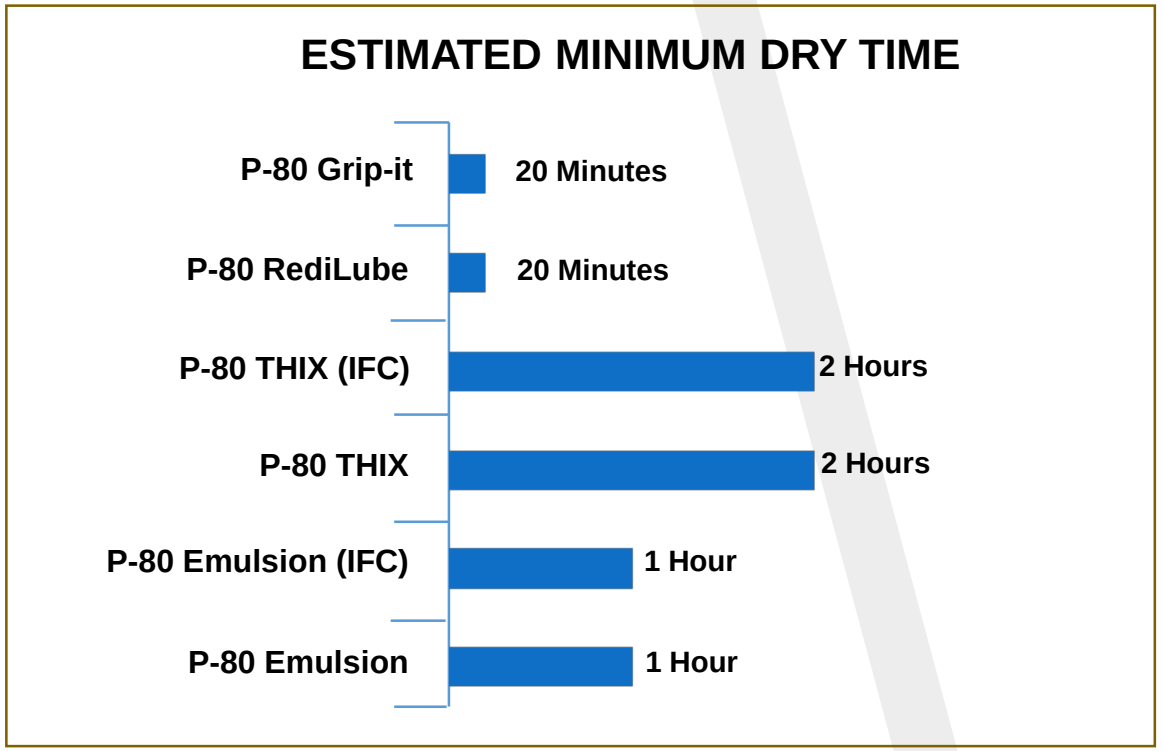
COORDINATION OF EFFORTS

Design: Lubrication vs Dry-Time





Reduction of friction data was created using a force gauge comparing both the dry and wet removal forces of hoses on an end cap. The equipment used; Mecmesin AFG 1000N force gauge, a Mecmesin Multi Test 2.5-d automatic test stand, and accessories to hold the cap and hose in place. The test stand is set to a fixed speed and path distance to control variability.

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LUBRICATION COMPARISON CHART

ESTER BASED TEMPORARY RUBBER ASSEMBLY LUBRICANTS	TRADITIONAL RUBBER ASSEMBLY LUBRICANTS
Provide lubricity and reduce friction.	Provide lubricity and reduce friction.
Temporary lubrication, once dry will not reactivate, resulting in tight fitting parts.	Continual lubrication, can reactivate in presence of water – resulting in problems with quality and consistency of finished product.
Will not dry out rubber or corrode metal parts.	Can dry out rubber and corrode metal parts.
Any residue is non-conductive.	Many additives are conductive.
Non flammable, negligible VOCs.	May contain VOCs. May be flammable.
Excess lubricant washes away easily.	In some cases may be difficult to wash away excess lubricant.
Compatible with elastomers and plastics. Will not swell rubber.	May not be compatible with elastomers and plastics. Can swell rubber.
Treated surfaces can be coated and painted afterwards.	May interfere with downstream coating and painting processes.
Environmentally friendly and non-hazardous.	Environmental and health hazards can exist.

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PRODUCT EVALUATION SUMMARY

- Is the product compatible with all of the materials it comes in contact with?
- Can supplier provide test results or assist with application-specific testing?
- How safe is the product?
- How is the quality and consistency of the product measured?
- Does it contribute to increased productivity and result in fewer part failures?
- Is it temporary?
- And especially for the Ergonomist:
  - *How well does the lubricant reduce the friction and effort required for worker safety?*

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Thank You!

Contact us for additional information

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