LUBRICATION RELIABILITY in Flour Milling Operations

- General Equipment Applications -
Milling operations vary in size, scope and equipment complexity
EVERYTHING THAT MOVES……

NEEDS LUBRICATION!
**Types of Maintenance Programs**

- Reactive or Run-to-Failure: 55% - 60%
- Preventative: 30% - 35%
- Predictive: 10% - 15%
- Other: 3% - 5%
  - Condition Based Maintenance
  - RCM - Reliability Centered Maintenance
  - TPM – Total Productive Maintenance
  - Plus Many, Many, Many More

[www.1eere.energy.gov/femp](http://www.1eere.energy.gov/femp)
Looks Nice….
Does It Work….
How do WE Make it Work?
Everyone Has Different Viewpoints?

Everything Costs Money?

What Will Work For Your Operation?

THE ASSET MANAGEMENT PYRAMID*

Continuous Improvement
TPM
Financial Optimization
Predictive Maintenance
Operations Improvement
RCM
Stores and Procurement
Work-flow System
CMMS
IP - Technical Training
Preventive Maintenance

*Engineer’s Digest February 2001

Assess

Design

Implement

Manage

Identify Opportunities
- Field Practices
- Lubrication Engineering
- Contamination Control
- Oil Analysis
- Training
- Cultural Awareness

Best Practices (ORS)
- Machine Review
- Equipment Mods.
- Lube Selection
- Lube Procedures
- Contamination Control
- Oil Analysis
- Storage/Handling
- Lube Routes
- Database
- Work Planning

Best Practices (ORS) Skills Training
- Procedures Deployment
- PM Tasks
- Work Scheduling
- Lube Routes

- Equipment Modification
- Lube Selection
- Consolidation

Continuous Improvement
Supervision and Coaching
Re-benchmarking

ORS = Optimum Reference State

Charles Brooks Associates, Inc. 843 831-8856

Lubrication Reliability – Flour Milling
Are You Doing Too Much PM?

16 Ways to Save Time and Money on Preventive Maintenance

Unless you've been living on another planet for the last fifty years, you already know that the case for doing preventive maintenance is water tight.

Done right, preventive maintenance will preserve, protect and extend the life of your equipment – and boost overall return on assets.

So here's the question: Why are most maintenance and reliability professionals so unhappy with their PM programs?

Surprisingly enough, according to the consultants at Life Cycle Engineering, just 22% of maintenance managers are satisfied with their current programs. Here are the two biggest complaints:

PM Consumes Too Many Resources

Many maintenance managers believe their PM program is simply bigger than it should be. They feel like they don't have enough manpower to manage all of their PM's along with the other important maintenance work, too.

Lack of Results

Despite all of the time and money being spent on preventive maintenance, there are still way too many unexpected equipment failures.

Case in point: During a recent chemical plant tour, the frustrated maintenance manager said, "We just PM'd that machine, and it failed a short time later anyway. So why didn't we catch the problem with the PM?"

Why indeed.

So in a nutshell, the problem with preventive maintenance is that it takes too much time and produces too little results.

Concerns of PM Processes & Practices
“Sure, I know. Preventive maintenance helps avoid unplanned downtime and breakdowns. But **PMs take a lot of time and cost a lot of money**, and they **don’t seem to make that much difference** in the way our equipment runs. We’ve got excess capacity anyway, and we’re not running production on all shifts during the week. So, **the downtime and repairs aren’t costing us that much in lost production**. We’re able to keep up with customer orders. **I really don’t see why we need to spend time and money on a PM program.**”

*Maintenance Becomes Deferred!*

How much time and money are you willing to spend on repairs and downtime?
America’s roadways. **Deferred maintenance** causes millions of dollars in damage to American automobiles every year. Lack of maintenance leads to the development of potholes at best, and roadway failures at worst. Currently, 32% of America's major roads are in poor or mediocre condition, costing U.S. motorists $67 billion a year or $324 per motorist, in vehicle repairs and operating costs, according to the 2013 Report Card for America’s Infrastructure by the American Society of Civil Engineers, which also cites roadway conditions as a factor in **one out of every three** traffic fatalities.
What is the **COST** of Equipment Ownership

What is the OEM Lifecycle Estimate?

What are the Equipment Lifecycle Costs?
Milling operations vary in size, scope and equipment complexity

• Critical Equipment – 80 / 20 Rule: 20 % of equipment produces 80% of product!

• RCA – Root Cause Analysis: What are the potential component failures and failure ratios of critical equipment and components?

• Lubrication Reliability Management Process or Program?

• Trained Lubrication Specialist? Lowest Paid or Highest Paid individual in maintenance department?

• Maintenance Practices: What are your Reliability Practices and Services utilized?

• KPIs: What are your Key Maintenance Performance Indicators?

• OEE & Maintenance Program Efficiency: Breakdown or Reliability Centered Maintenance?
RCA or RCFA

Different Lubricant Regimes Address Different Failure Modes!

Is Your CMMS Up To Date?
Failure Curve

demonstrates the relationship between machine breakdown, cost, and how it can be prevented.
- Lubrication Excellence – Skills and Knowledge of Best Lubrication Practices
- Precision Maintenance – Skills Driven Maintenance & Repair (Millwright)
- Ultrasound, Vibration, Thermal Imaging, Oil Analysis, Alignment, Balance, etc.
- Select Suppliers – Business Partners & Solution Providers
- Metrics – KPIs (Key Performance Indicators), Measurable Outputs
- Equipment Ranking - Criticality
- RCM – Reliability Centered Maintenance
- TPM – Total Productive Maintenance
- RCA / FMEA / RCFA – Root Cause Analysis / Failure Mode Effects Analysis / Root Cause Failure Analysis
- RCD – Residual Current Device for Electrical Testing
- Training Programs – Personal Development & Skills Advancement
- Written Procedures - SOPs
- Job Planning/Scheduling – Work Order, Manpower, Operations, etc.
- CMMS System – Computer Maintenance Management System
- OEE – Availability X Performance X Quality – measurement of efficiency of a manufacturing operation
- R&M – Repair and Maintenance
Lubricant Myths & Mistakes

• Oil is Oil and Grease is Grease!

• If a LITTLE bit of Grease is Good….

• New Oil is Clean……..

• No One Wants to Be the Lube Guy!

• How many lube points are there?

• It doesn’t matter what position the gearbox is in……..

• Others……..
Maintenance and Reliability Groups, Conferences & Training

• STLE - Society of Tribologist and Lubrication Engineers
• SMRP - Society of Maintenance and Reliability Professionals
• PRMP - Plant Reliability and Maintenance Professionals
• MCRG - Maintenance Centered Reliability Group
• RMC - Reliability Management Council
• Reliability 2.0 Conference
• Reliability & Maintenance Conference
• Reliability Plant 2015 Conference
• International Council for Machinery Lubrication (MLA I, II, MLT II, III, LLA I)
• Lifecycle Engineering
• Marshall Institute
• Allied Reliability
• IDCON
• Lifetime-Reliability
• Hydrotex Lubrication University
The Bottom Line Impact of Lubrication

Industrial Lubricants Typically Account for just 1% of Plant Operating Costs

- Depreciation: 15%
- Utilities: 19%
- Overhead: 35%
- Maintenance: 30%
- Lubricants: 1%

The proper selection and application of lubricants will improve overall profitability.

- **Utilities:** Proper lubrication can reduce energy usage over 10%.
- **Maintenance:** Over 30% reduction in maintenance expense can be achieved with proper lubrication and Lubrication Management.
- **Overhead:** Reduce spare parts inventory and labor costs with extended maintenance intervals.
- **Depreciation:** Equipment lasts longer and improves ROI.
Milling Operations L.E.T.S.

**Load** varies on equipment depending on operation and configuration.

**Environment** varies – exterior and interior applications, explosive conditions due to high dust levels, flour or corn dust acts as an insulator on equipment raising operating temperatures, contaminates grease and oils. Equipment may be located at top of buildings to lower or basement levels.

**Temperatures** vary depending on where mill is located, equipment locations and operating conditions as well as age of equipment.

**Speeds** vary depending on production and equipment application specifications. RPM’s may run from 50 to 3600.

Operations and maintenance personnel are limited due to production costs and competition.
Asset Lubrication Practices

Identify components and develop SOPs for correct lubrication processes

Motors

Gearboxes

Bearings

Chains or Belt Drives

Slides & Ways

Pneumatics

What is the COST of ownership?

Other Applications
Asset Lubrication Practices

- Define **Criticality of Assets**.
- Identify **correct lubrication, points, amounts and frequencies** using OEM recommendations and L.E.T.S.
- **Consolidate** lubricants to reduce cross contamination issues with labeling program.
- **Implement** Oil Analysis practices as needed.
- **Utilize** Ultra Sound, Vibration Analysis, Thermal Imaging, Fluid Filtration.
- **Train** maintenance and operations personnel to perform lubrication tasks.
- **Develop** SOPs and Work Orders that define lubrication specifications.
- **Implementation of processes and practices** over time
- **Action planning – Responsibility & Accountability**
Elevator Area:
- Head House
- Sifter Area
- Tripper/Conveyors
- Truck & Rail Load Out Areas

- Motors
- Belt or Chain Drives
- Gear Boxes
- Motor / Gear Reduces
- Bearings
- Bucket Elevators
- Drag Conveyors
- Tripper / Belt Conveyors
- Blower Systems
- Air Locks
- Hydraulic Systems

Single Point Lubricators on all points where applicable
Belt Conveyors

- V-Belt Trough Bearings
- Intermediate Bearings
- Support / Return Bearings

- Motor
- Belt or Chain
- Gearbox
- Drive / Head Bearings
- Support Bearings
- Take Up / Tail Bearings
Re-lubrication = 4,000 to 6,000 hours
- 24 x 6 x 52 = 7,488 hrs. annually
- 1.9 times per year or 1.3 times per year
- Recommend 1 ounce of grease per 7 to 10 strokes of the lever.
- All fittings should be wiped clean before lubricating
Bearings & Greasing

- Design and Application
- Installation Practices
- Load, Environment, Temperature & Speed
- PM verses Condition Based Maintenance

6 Different Types of Bearings and Configurations

100 % Pack

50 % Pack

- High Load / Low Speed

30 % Pack

- Light Load / High Speed

Lubrication Reliability – Flour Milling
4 Bolt Flange Bearing

What position should the bearing be mounted?

What is the bolting pattern?

What is the torque value?

Does the installation need shimming?

What lubricant comes in the bearing?

Is my current grease compatible?

How often does the OEM recommend re-lubrication?
### Bearing Lubrication Calculations

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<th>Width</th>
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Every 20° F degree increase above normal operating temperatures the life of the lubricant is reduced by 50%.

Every 20° F degree decrease in normal operating temperatures the life of the lubricant is doubled.

Increased temperature = increased electrical and maintenance costs!
Hydraulic Truck Lift
- Check Filtration Efficiency
- 4406 ISO Fluid Cleanliness Code

A 25 GPM pump operating continuously in hydraulic oil at a 22/19/17 cleanliness level will circulate 3,500 pounds of dirt to the hydraulic system's components each year! (Insider Secrets to Hydraulics)
Drag Conveyors - motors, gearboxes, drive and take-up bearings

Single Point Lubricators as needed
Elevator – Single Point Lubricator on motor, gear boxes and bearings

Air Handling Unit – Single Point Lubricator on motor and bearings
Fans

Exhaust
Air Induction Filtration

Shaft Bearings (2)

Belt or Chain Drive

Motor Gearbox or Direct Drive

Single Point Lubricators
Motor and Bearings

Lubrication Reliability – Flour Milling
Motor Lubrication Related Failures

13% Motors Fail Due To Bearing Failure

60% Bearings in a Facility Caused by Wear
Screw Conveyors – motors and gearboxes
Drive & Take-up Bearings
Feed Screw Conveyors:

- Motor
- Motor/Gear Box
- Belt or Chain Drive
- Drive Bearings
- Take Up / Tail Bearings

(note angle of gearbox)

Single Point Lubricators motors, drive and take-up bearings
Gearbox / Reducer Lubrication

- How much oil should be used.....10% angle, 20% angle, 33% angle?????

Splash Lubrication

Correct Motor to Gear Box Ratio?

Lubricant Level (?)

WHERE?

Breather Cap or Desiccant with filtration
Controls contamination, moisture, etc.

Oil Level
- 6 Positions
- 6 Oil Levels
- Loss of Lubricating Properties
- Higher Operating Temperatures
- Higher Energy Costs
- Seal Issues
- Bearing Issues
- Higher Maintenance Costs
- Higher Downtime Costs
- Less OEE / Production

Where does contamination come from?
Blowers and Compressors are the most neglected equipment in an operation!

- Air Flow – Filtration
- Temperatures
- Desiccant Air Breathers - Reservoirs
- Oil Analysis
- Which Oil – Hydrocarbon, Synthetic, Food Grade?
- Which ISO grade – 150, 220, 320?
- How often do I change oil?
- When do I lubricate the motors?

Blower Room – motors, gearboxes and bearings temperature tracking is important

Energy Reduction:
(varies by size of mill and number of blowers)

36 blowers x $700 avg.
$25,200.00
Annual Oil Changes
Screw Type
• Air Filtration
• Right Oil & Viscosity
• Oil Filtration
• Operating Temperature

Reciprocating Type
• Air Filtration
• Right Oil & Viscosity
• Oil Filtration
• Operating Temperature
Lubrication Operator or Mechanic
- Operator Based
- Maintenance Based
- Designated Lubrication Technician
- Automation

Typical Mill Floor Equipment Layout
Critical Equipment

Ocrim / Buhler Roller Mill - grease motors and bearings
gear oil, hydraulic oil for brake, bearing temperature tracking
Great Western Vibratory Unit – grease bearings

Screw Conveyor – Motors, Gearbox
Single Point Lubricators - drive and take-up bearings
Giant Sifters:

- Motors
- Belt or Chain Drive
- Gearbox
- Drive Shaft Bearings
- Support Shaft Bearings
- Lower Shaft Bearings

Single Point Lubricators
Upper, Support and Lower Bearings
Aspirators / Separators:

- Motors
- Belt Drive
- Upper Drive Bearings
- Intermediate Bearings
- Lower Drive Bearings

Issues:
- Bearing Failure
- Downtime Cost
- Maintenance Costs
- Lost Production
- Safety
Overhead Screw Conveyor - Motor, Belt Drive, Gear Box, Drive Bearing, Tail Bearing – How Do You Lubricate Safely?
Packaging & Bagging Area:

- Motor
- Belt or Chain Drive
- Motor-Gear Box
- Drive Bearings
- Intermediate Bearings
- Take Up Bearings
- Roller Bearings

Multiple Conveyors
Bagging and Palletizer

- Motors
- Belts
- Gearboxes
- Bearings
- Chains
Product Storage
Silos or Bins

Blowers
Screw Conveyors

Single Point Lubricators
as needed
Bulk Storage Tanks:

Motor / Gear Reducer
Rotary Air Lock

- Screw Conveyors
- Motor
- Belt or Chain Drive
- Gear Box
- Drive Bearings
- Take Up / Tail Bearings
Blower Area:

Transfer of finished product to packaging
Product transfer blowers – motors, bearings, gearboxes
Rotary Air Locks
2 / 4 / 6 / 8 pockets

Shaft Support Bearings

Measures amount of product introduced into the airflow or production line

Single Point Lubricators on each support bearing
20 – 100 air locks
Bagging Area:

- Motors
- Gearboxes
- Bearings
- Belt or Chain Drives
- Conveyors
- etc......
Bagging Area

Finished Product Conveying
Palletizing & Warehouse:

- Motors
- Belt or Chain Drives
- Gearboxes
- Bearings
- Chains
- Hydraulic Systems

Upper Belt or Squeeze Belt
Lower Belt

Pallet Machines
- Wrappers
- Roller Conveyors
- Fork Lifts
Truck Load out Area
motors and bearings

Single Point Lubricators
as needed
Support Equipment: Yard Pup, Rail Car Spotter, portable compressor unit, generator
Cost of Lubrication – Manpower and Lubricants!

- 30 seconds to lubricate a grease fitting properly X the number of grease fittings?
- 30 minutes to drain and refill a small gearbox X the number of gearboxes?
- 4 hours to drain and refill large / leg gearbox X the number of gearboxes?
- 1 hour to drain / fill and grease forklift X the number of forklifts?
- ____ time to gather lubricants and supplies?
- Which and How much grease (NLGI) or oil (ISO) does the work order call for?
- How many hours does the Lubrication Engineer have to do the work?
- What support equipment is needed, additional manpower, etc.
Setting Customer Expectations

The three major goals of operations and maintenance are:
- Improve Output Capabilities
- Reduce Operating and Maintenance Costs
- Increase Profitability

Maintenance and overhead account for 65% of facilities' expenditures and by adding utilities, the costs can soar to 84%. Lubricants typically account for just 1% of plant operating expenses, but they affect the whole operation. Utilizing the proper lubricants and Lubrication Management will reduce reactive maintenance and unplanned downtime.

Hydrotex assists customers in identifying, developing and implementing continuous improvement processes in the fields of Preventive and Predictive Maintenance, Reliability and Facility Operations. We utilize on-site services, programs and training combined with superior high performance lubricants to meet our customers' expectations.

Hydrotex develops a unique plan for each customer. This plan is designed to provide the following services, programs and products based on the facilities' actual needs and goals:
- Equipment and Application Surveys
- Lubrication Audits
- Product and Solution Recommendations by Application
- Critical Equipment Identification and Tracking Program
- Cost Analysis, Return-On-Investment Processes and Equipment Energy Studies
- Implementation Plans, Time Tables and Process Management
- Training and Continuous Education Programs
- Oil and Fuel Analysis Programs
- Facility Equipment and Application Inspections
- Reporting Practices, Quarterly Reviews and Follow-up

The Hydrotex team works closely with local and corporate contacts to develop a successful process. Our team includes the local Hydrotex Lubrication Consultant, area Division Partner and corporate Market Segment Leader. Every team member receives a minimum of 40 hours of training annually and is responsible for helping our customers meet their corporate goals.

Our products and solutions complement a proactive lubrication and maintenance approach and result in one lubrication supply source, consolidation of effort, optimized efficiencies and sustainable solutions.

What is a World Class Lubrication Reliability Process?

How Does a World Class Lubrication Reliability Process Tie Into Maintenance Programs?

What is The Cost of A World Class Lubrication Reliability Process And Maintenance Program?
## FACILITY LUBRICATION MANAGEMENT PROCESS: IMPLEMENTATION PROGRAM

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## Lubrication Management Process Action Planner

### Project Name: XYZ Customer

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<tr>
<th>Item #</th>
<th>Priority</th>
<th>Area</th>
<th>Action Item</th>
<th>Start Date</th>
<th>Original Due Date</th>
<th>Current Due Date</th>
<th>Point Person</th>
<th>Status</th>
<th>Comments</th>
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<tr>
<td>1</td>
<td></td>
<td>XYZ Customer - Management Team</td>
<td>Introduction of Hydrotex Lubrication Management Process</td>
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<td>Plant Manager</td>
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<td>Discuss Lubrication Management Process</td>
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<td>XYZ Maintenance and Operations</td>
<td>Review Plant operation - walk through</td>
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<td>Maintenance Manager</td>
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<td>Reviewed production equipment. Looked at blower operation, ovens.</td>
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<td>XYZ Maintenance and Purchasing</td>
<td>Obtain current lubrication list and usage rates</td>
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<td>Maintenance Manager</td>
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<td>Reviewed lubrication storage area and collected current lubrication</td>
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<td>Hydrotex Lubrication Management Process</td>
<td>Provide Hydrotex Lubrication Implementation Plan as example and as planning tool</td>
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<td>Alan Harding</td>
<td></td>
<td>Obtain usage rates per Blowers, implementation plan, develop plant plan</td>
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<td>Hydrotex Lubrication Management Process</td>
<td>Provide Temperature Tracking Program Critical Equipment Example</td>
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<td>Sand Temperature Tracking Example</td>
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<td>Hydrotex Lubrication Management Process</td>
<td>Action Planner</td>
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<td>Provide Plant Action Planner</td>
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<td>Hydrotex Lubrication Management Process</td>
<td>Provide Lubricant Crossover Survey</td>
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<td>Alan Harding</td>
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<td>Cross over current lubricants to Hydrotex recommended lubricants. Confirm</td>
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<td>XYZ Customer - Operations and Maintenance</td>
<td>Determine Critical Equipment</td>
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<td></td>
<td>OEM lubricant recommendations on critical equipment</td>
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<td>Hydrotex Lubrication Management Process</td>
<td>Visit plant, temperature review, Critical Equipment, etc.</td>
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<td>Alan Harding</td>
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<td>Meet appointment with Paul Delao and develop temperature tracking,</td>
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<td>10</td>
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<td>Hydraulic Systems</td>
<td>Use oil samples to determine fluid cleanliness of each system. Flush and Fill?</td>
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<td>Hydraulic Technician</td>
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<td>Blowers, ovens, other critical.</td>
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<td>11</td>
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<td>Equipment Review and Inspection</td>
<td>Hydrotex to visit plant and review equipment applications</td>
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<td>Alan Harding</td>
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<td>Samples provided to Polaris</td>
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<td>12</td>
<td></td>
<td>Lubrication Reliability Team</td>
<td>Develop LRT - Maintenance Manager, Lead Mechanic, Operations and Engineering Hydrotex</td>
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<td>Maintenance Manager</td>
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<td>Assign key personnel to Lubrication Reliability Team</td>
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</tbody>
</table>
Hydrotex Technical Response Team:

- 50 Years of Experience
- Society of Tribologist & Lubrication Engineers - STLE
- Society of Maintenance Professionals – SMRP
- Return-on-Investment and Energy Studies
- Facility Survey Process
- Lubrication and Application Recommendations
- Technical Issues and Concerns
- Root Cause Failure Analysis
- Lubrication and Application Training Programs
- Facility Specific Training Programs
Hydrotex Lubrication University:

- 3 Day Intensive Lubrication School on a Quarterly Basis
- On-Site Principles of Lubrication Class
- Customer Professional Development Internet Courses
- Application Specific Lubrication Courses
- Facility Specific Lubrication Courses
- Internet – Live Instructor / Application or Skill Specific Courses

Hydrotex Lubrication University and Courses are approved to meet:

- Recertification for International Council for Machine Lubrication / MLA I, II, and MLT I, II and III
- Recertification for SMRP
- Recertification for STLE
- CEU – Continuing Education Credits
Reduce Costs
Increase the R.O.I.
10%
30%
40%
?

The proper selection and application of lubricants will improve overall profitability.

- **Utilities**: Proper lubrication can reduce energy usage over 10%.
- **Maintenance**: Over 30% reduction in maintenance expense can be achieved with proper lubrication and Lubrication Management.
- **Overhead**: Reduce spare parts inventory and labor costs with extended maintenance intervals.
- **Depreciation**: Equipment lasts longer and improves ROI.
Alan Harding
aharding@hydrotexlube.com
972-389-8500

Lubrication Management Process

- Define Goals & Develop Implementation Plan
- Review OEM Recommendations, Previous Years' Lubrication Problems, Usage and Expense
- Introduce Principles of Lubrication (POL) Training
- Agree on Historic Lubrication Costs & Maintenance Activity Levels
- Commit to Changeover to Hydrotex® Lubricants & Methods
- Conduct A Hydrotex* Survey and Confirm OEM Recommendations
- Approve the Hydrotex* Survey
- Conduct Customer Specific Lubrication Training
- Conduct Root Cause Analysis & Solutions for Significant Lubrication Issues
- Implement Standard Operating Procedures (SOP) & Lubrication Practices
- Implement Fuel Analysis Program
- Implement Extended Drain Intervals & Oil Analysis Program
- Develop Key Metric Reporting
- Continuous Improvement & Ongoing Training

Improved Output Capabilities
Reduced Operating Costs
Increased ROI
Reduced Carbon Footprint

*There are Several Types of Hydrotex® Surveys