



## Contamination Control for the Refuse Industry



# The Refuse Industry

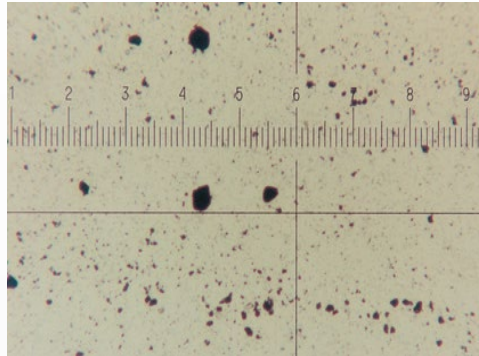
**Contamination  
Control  
for the  
Refuse  
Industry**

- **Schroeder is a proven leader in the Refuse Industry:**
  - **Extensive field testing**
  - **Long term relationships with truck OEM's**
  - **Supply partnerships with major refuse industry service providers**

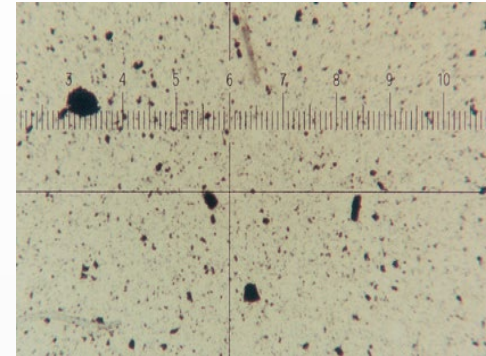


# Is New Oil Clean Oil?

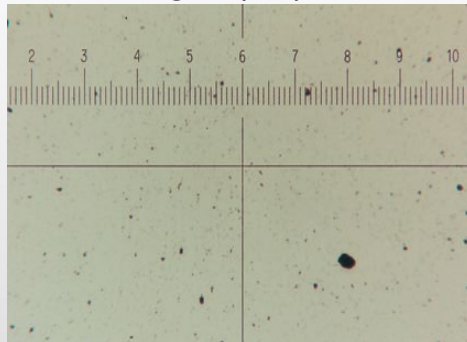
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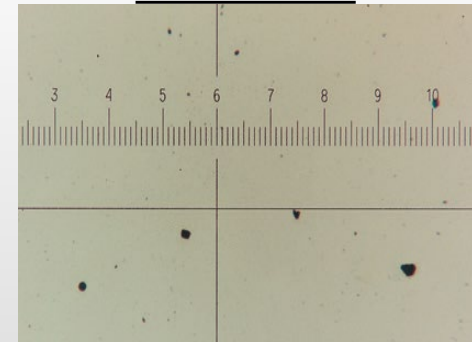
Typical bulk oil at delivery  
ISO 22/21/17



Typical new oil in barrels  
ISO 23/21/18



Hydraulic pump requirements  
ISO 19/17/14



Target cleanliness (CAT)  
ISO 18/16/13 Or better

“ At present, there are no industrial standards that outline even minimal requirements for product handling and delivery to the end user.” (Machinery Lubrication, 2003)



# What is Contamination?

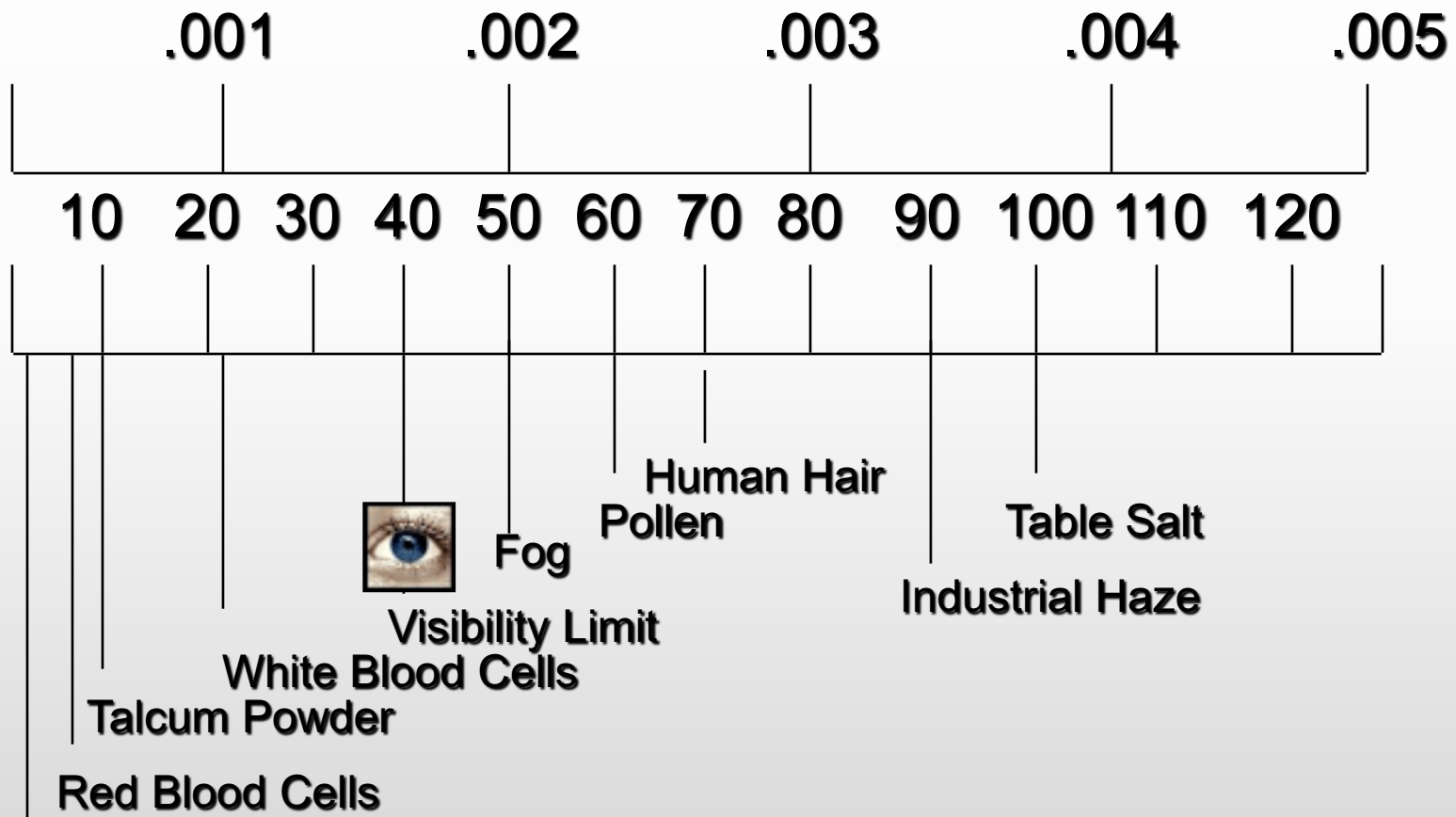
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**Contamination is any Foreign Matter  
Introduced into a Hydraulic System**



# Sizes of Known Particles in Inches & Microns

Contamination Control for the Refuse Industry



1 micron = .000001 meter = .00004 inch



# Contamination May Be...

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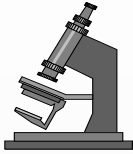
## Particles We Can See:

- **Weld Spatter**
- **Machine Cuttings**
- **Rubber dust from making hoses**
- **Sludge**
- **Floor Sweepings**
- **Metal from Damaged Components**
- **Paint Chips**
- **Rust**
- **Rags and Plastic Caps Left in Component when Installed**



# Contamination May Be...

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## **Particles We Cannot See (less than 40 microns)**

- **Airborne Dust**
- **Metal Particles Internally Generated or Externally Induced**
- **Silt Particles**



## **Fluids**

- **Water**
- **High Pressure Wash Down Cleaning Solutions**
- **Other Chemicals: diesel fuel, anti-freeze, solvents**



# Contamination Will Cause...

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- **Premature wear and failure of hydraulic components**
- **Hydraulic leakage**
  - **Internal (reduced power, speed, heat)**
  - **External**
- **Erratic performance**

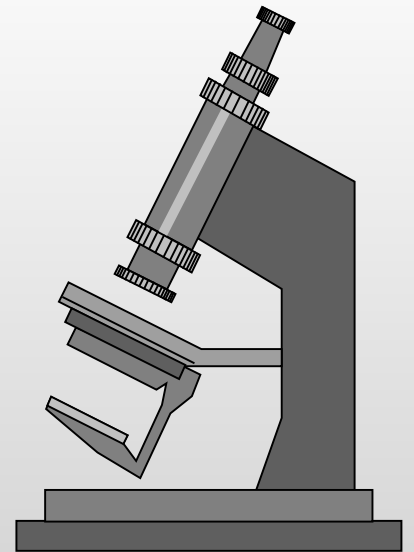




# Damage Caused By Contamination

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Industry**

- **Surface Scoring and Wear Causes:**
  - Internal Leakage causing
    - Loss of Cylinder Speed
    - Loss of Holding Characteristics
    - Heat
  
- **Fine Particle Buildup Causes:**
  - Erratic Performance
  
- **Fluid Degradation Causes:**
  - Rust





# Contamination

## Contamination Control for the Refuse Industry

### Cause

- Improper filtration
- Low oil level - concentration of contaminant
- Loose or lost breather cap
- Leaking fittings, seals, wipers
- Missing or collapsed inlet strainer
- Poor fill practices
- Clogged filter - by-pass

### Effect

- Accelerated wear bearings, thrust plates, housing
- Bearing / bushing failure
- Reduced pump efficiency
- Reduced life
- Heat
- Internal leaks
- Failed pump



# Cavitation Damage

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## **Cause - Inlet restriction**

- Clogged inlet strainer / breather
- Inlet strainer too small
- Inlet line too long
- Inlet line bore too small
- Excessive engine speed
- Collapsed inlet hose
- Suction head too great
- Oil too viscous (cold weather)

## **Effect**

- Noise
- Heat
- Accelerated wear thrust plates / housing
- Internal leaks
- Reduced pump efficiency
- Erratic actuator performance
- Failed pump



# Aeration Damage

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## **Cause - Air enters Oil**

- Low oil level
- Vortexing of oil above strainer - whirlpool
- Loose inlet fittings
- Worn pump shaft seal
- Worn cylinder rod seal
- Foam suspended in oil due to sloshing in the reservoir

## **Effect**

- Noise
- Heat
- Accelerated wear thrust plates / housing
- Internal leaks
- Erratic actuator performance
- Reduced pump efficiency
- Failed pump



# Pressure Damage

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## Cause

- Improper relief valve setting
- Relief valve malfunctioned
- Slow acting relief valve
- Absence of a relief valve
- Improper size elbow or fitting downstream of the valve affecting the relief valve performance

## Effect

- Accelerated wear
- Cracked housings
- Excessive housing cut-out
- Reduced efficiency
- Internal leakage
- Bearing / bushing failure
- Thrust plates coined, warped or cracked
- Broken drive / connecting shaft



# Heat Damage

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## Cause

- Low oil level
- Cavitation / aeration / water
- Contamination
- Inlet restriction
- Relief valve
- Incorrect fluid
- Poor reservoir design
- Undersized fittings, hoses, components

## Effect

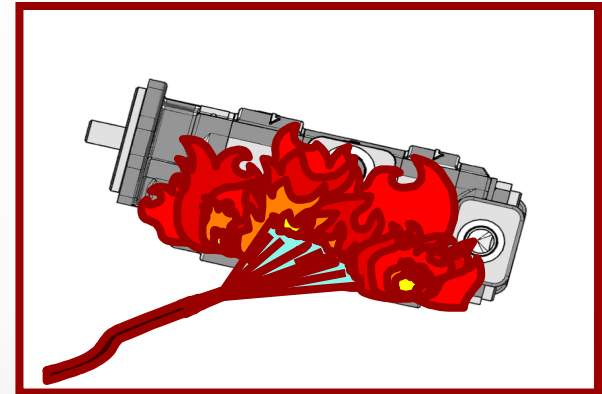
- Breakdown of oil
- Loss of lubricity
- Accelerated wear
- Reduced efficiency
- Leakage
- Varnish / sludge
- Internal seal destruction
- Seizure

# Heat



## Contamination Control for the Refuse Industry

- **Thins system oil**
  - increasing friction
- **Accelerates breakdown of oil**
  - causing sludge to form
- **Can be caused by worn components**
- **Every 18° F rise in oil temp**
  - doubles the rate of corrosion on exposed surfaces





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# **SOURCES OF CONTAMINATION**





# Sources of Contamination

## Contamination Control for the Refuse Industry

- **Built-In** - during manufacture and assembly
- **Ingested** - from environment through cylinder seals, fluid filler caps and breathers
- **Internally Generated** - as system contaminants interact with components and other contaminants
- **Introduced During Repair or Service** - from dirty parts on shelves, dust and dirt blowing in air, adding oil.



# Sources of Contamination

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**Bulk oil tank and  
oil transfer**



**Air breather on reservoir**



**Cylinder rod**



# What Causes Internally Generated Contamination?

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- **Abrasive Wear**
- **Cavitation**
- **Erosion**
- **Corrosion**
- **Overheating**



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Industry**

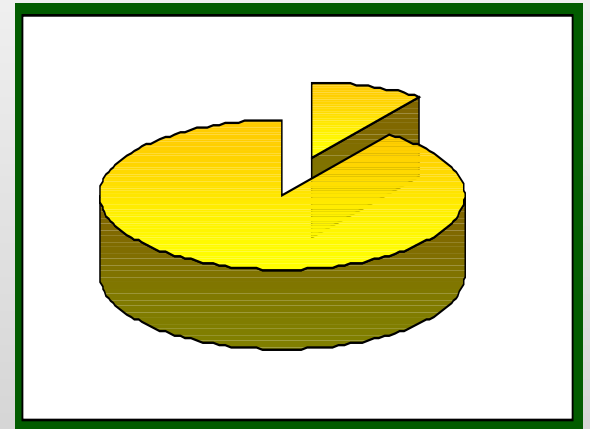
# WHY CONTROL CONTAMINATION?



# System Failures

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- **90%** Of all Hydraulic System Failures can be Traced to Contamination





# System Failures (con't.)

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## Verified by:

- Caterpillar Study
  - Hydrostatic Drives
  - “Repair Before Failure”
- British Off-Road Vehicle Research Study
  - 117 Vehicles
  - 3 Year Study
  - Component Failures Reduced By 90%
- Nippon Steel Study
  - Hydraulic Pumps
  - Proper Filtration Enhances Contamination Control



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# HOW TO CONTROL CONTAMINATION





# How to Control Contamination

## Contamination Control for the Refuse Industry

- Maintain Proper Filtration and Monitor Hydraulic System Cleanliness
- Fluid Storage and Handling
- Parts Storage and Handling
- Parts Installation
- Flush Hydraulic System





# Typical Fluid Transfer – Poor Practice

Contamination Control for the Refuse Industry



Hydraulic fluids





# Typical Fluid Transfer – Poor Practice (cont)

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**Hydraulic fluid dispenser**





# Parts Storage & Handling – Best Practice

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- Store Parts in Clean Area
- Plug All Port Openings in Components, Manifolds, Hose and Tube Assemblies
- Keep All Hydraulic Components Plugged Until Flushed or Installed in Vehicle



# Parts Storage & Handling (con't.)



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Stored parts



Plugged port  
openings



# Common Shop/Maintenance Poor Practices

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- **Unprotected Parts Storage**
  - Caps
  - Cylinders
  - Hoses
- **Dirty Parts**
  - Metal Contamination
  - Dirty Cylinders
- **Open Fluid Containers**

# Common Shop/Maintenance Poor Practices



## Contamination Control for the Refuse Industry



Open cartons



# Common Shop/Maintenance Poor Practices (con't.)



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**Dirty, unprotected caps**



# Common Shop/Maintenance Poor Practices (con't.)



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**Unprotected  
cylinders**



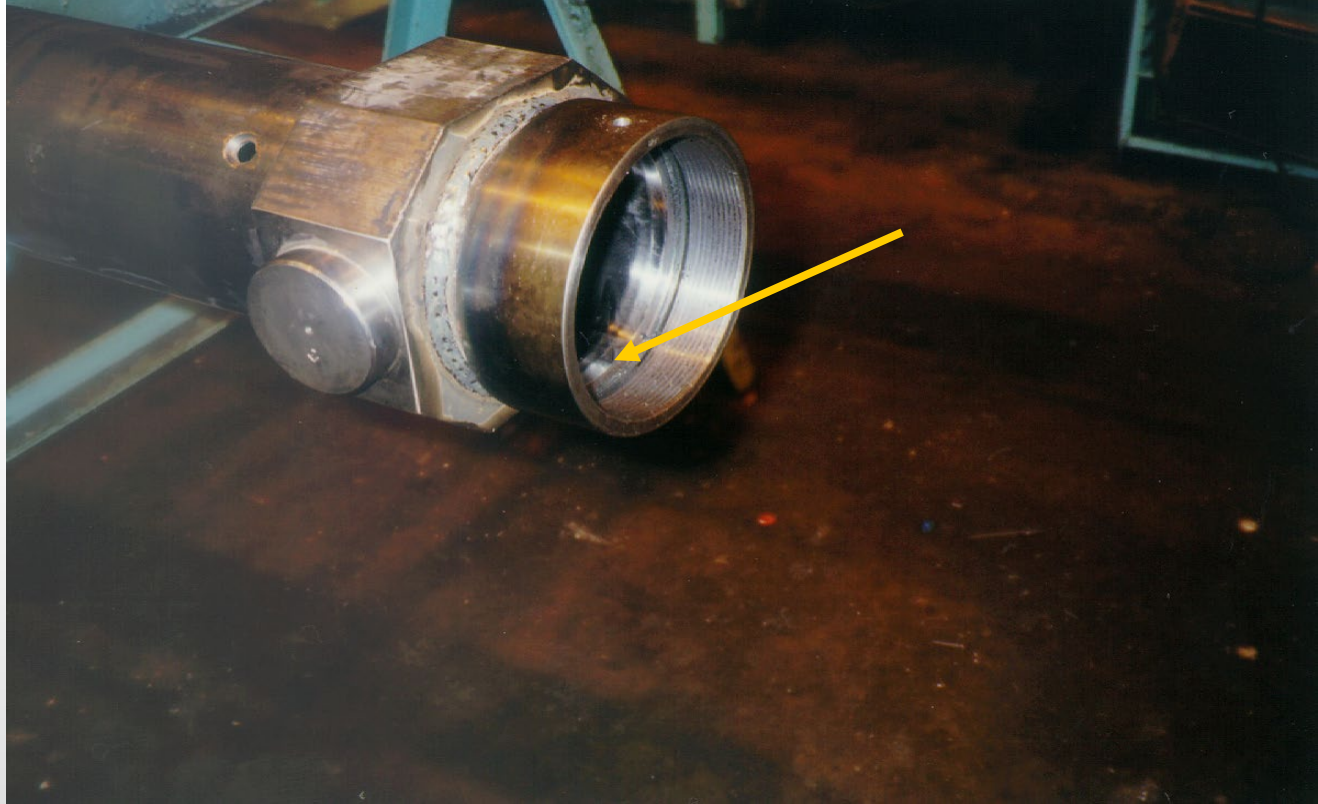
**“Clean” cylinder**



# Common Shop/Maintenance Poor Practices (con't.)



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**Visible metal particle contamination**

# Common Shop/Maintenance Poor Practices (con't.)



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**Unprotected hoses**





# Fluid Storage & Handling

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Bulk Oil Tanks  
and Drums





# Common Shop/Maintenance Poor Practices (con't.)

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Industry



Open fluid  
containers





# Common Shop/Maintenance Poor Practices (con't.)

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for the  
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Industry**



**Open fluid  
containers**





# Fluid Storage & Handling – Best Practice

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Industry**

- Store Fluid in Clean, Dry Container
- Do Not Mix Fluids
- Pre-filter Fluid Before Filling Reservoir
- Fill Through Fill Cap Strainer on Reservoir





# Bulk Fluid Filtration – Best Practice

Contamination Control for the Refuse Industry





# Fluid Storage & Handling – Best Practice (con't.)

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**Portable Filtration Carts  
(transfer, recirculation,  
flushing)**





# Parts Installation – Best Practice

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Industry**

- **Keep Work Area Clean**
- **Inspect Parts for Contamination Before Installing in System**
- **Make Sure Cylinder Rods are not Painted**



# Flush Hydraulic System – Best Practice

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- **Thoroughly Clean All Hydraulic Components Before Assembly**
- **Flush All Hydraulic Plumbing Before Final Installation**
- **After Final Assembly, Flush Total Hydraulic System Thoroughly**



# Flush Hydraulic System – Best Practice (con't.)

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Industry**



**Asset  
Management  
Filtration  
Station**



**MFS- Hytrax  
Portable filter  
Cart**



**MFS- Portable  
filter Cart**

# Maintain and Monitor Filtration – Best Practice



## Contamination Control for the Refuse Industry

- Check Condition of Filter Caps/Breathers
- Monitor Dirt Alarm and Replace Filter Element if Necessary
- Take Oil Samples and Check for Particle or Water Contamination
- Compare Results with Corporate Guidelines for Contamination Levels





# Monitor Filtration Results – Best Practice

Contamination Control for the Refuse Industry

**TROUBLE CHECK PLUS ANALYSIS REPORT** Page 1

**Schroeder INDUSTRIES**  
THE FILTER COMPANY

Nichol Ave. Box 72 McKees Rocks, PA 15136

SAMPLE CODE: 73831 Report 06/25/01

TEST: TCP 3

Report Information: 412/771-4810

COMPANY NAME: XYZ  
SYSTEM TYPE: Hydraulic  
EQUIPMENT TYPE: Alum. Roll Haler  
MACHINE ID: 06-Roler-36  
FILTER ID: RT2-427-PP-YZ

SAMPLE DATE: 6/13/2001  
HOURS: (on oil): 708 (on unit): 10744  
SYSTEM VOLUME: 250 Gallons  
FLUID TYPE: Mobil DTE 25  
ANALYSIS PERFORMED: N,S,T,V,W

Size	Count per ml	ISO Code	FREE WATER PRESENT
4 µm(c)	3312.3		
6 µm(c)	886.8		
10 µm(c)	222.3		
15 µm(c)	101.0	19/17/14	
30 µm(c)	49.9		
50 µm(c)	16.5		
60 µm(c)	8.5		
80 µm(c)	6.3		

**PHOTO MICROGRAPHS**

The photomicrograph is taken at 160X magnification of a filter patch that has had 20 ml. of the fluid drawn through it. The photo, with divisions equal to 20 microns, shows a magnification of the actual contaminant in the fluid sample.

**ALARMS/REMARKS**

The particle count is conducted using an automatic particle counter calibrated to ISO Standard 11171-1999. The Cleanliness Code is the ISO 4406-1999 Code Rating at 4µm(c), 6µm(c), & 14µm(c).

**TROUBLE CHECK PLUS ANALYSIS REPORT** Page 2

**Schroeder INDUSTRIES**  
THE FILTER COMPANY

Nichol Ave. Box 72 McKees Rocks, PA 15136

SAMPLE CODE: 73831 Report Date: 6/25/2001

TEST: TCP 3

Report Information: 412/771-4810

SPECTROMETRIC ANALYSIS		
WEAR METALS AND ADDITIVES	PPM BY WEIGHT	STATUS
IRON	6.0	
COPPER	9.0	
CHROMIUM	<1.0	
LEAD	<1.0	
ALUMINUM	<1.0	
TIN	<1.0	
SILICON	<1.0	
ZINC	719.0	
MAGNESIUM	<1.0	
CALCIUM	105.0	
PHOSPHORUS	506.0	
BARIUM	<1.0	
BORON	<1.0	
SODIUM	<1.0	
MOLYBDENUM	<1.0	
SILVER	<1.0	
NICKEL	<1.0	
TITANIUM	<1.0	
MANGANESE	<1.0	
ANTIMONY	<1.0	

**ALARMS/REMARKS**

The Spectrometric Analysis reports the ppm level of 20 different wear metals and additives in the sample. Generally the first 7 and last 5 elements are considered wear elements - elements not normally present in hydraulic oil. Zinc through molybdenum (shaded) represent some common additives in oil.

If a baseline oil sample (new oil out of a drum) is provided, then comments on the analyzed sample can be provided on whether the status of the elements are low, normal, or high.

**VISCOSITY ANALYSIS - ASTM D445**

CST@100C:	SUS@210F:
CST@40C: 62.8	SUS@100F: 246.0

Viscosity at 40C (100F) is reported in Centistokes (cSt) and SUS (Saybolt Universal Seconds). The test is conducted in accordance with ASTM D445 procedures for determining the kinematic viscosity of fluids.

**WATER ANALYSIS - ASTM D6304**

WATER CONTENT (ppm):	198.6
----------------------	-------

The water analysis test shows the actual parts per million of water in a sample. This is known as the Karl Fischer Titration test & is conducted in accordance with ASTM D6304.

**NEUTRALIZATION ANALYSIS - ASTM D974**

TAN:	1.32
------	------

The Total Acid Number (TAN) test measures the acidity of a hydraulic fluid. The higher the number, the more acidic the fluid. Over time this may mean the fluid is becoming oxidized.



## Oil Analysis Report





# Schroeder Industries

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## Contamination Control Products



# Core Product Offerings - Elements



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- **Excellement™ Synthetic**
- **Cellulose**
- **Water Removal**
- **BestFit™ Replacement Elements**
- **Air Breathers**

# Core Product Offerings - Housings



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Industry**



## **Filter Housing Types:**

- Low Pressure
- Medium Pressure
- High Pressure
- Suction
- Sandwich
- Cartridge



## **Filter Housing Configurations:**

- In Line-Mounted
- Base-Mounted
- Tank-Mounted Filters

# Core Product Offerings – Specialty Products



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- **Filtration Carts**
- **Suction Strainers**
- **Magnetic Separators**





# Typical Applications for Schroeder Filtration Carts

## Contamination Control for the Refuse Industry

- Filtering of Contaminated Hydraulic Fluid in Reservoir
- Clean-up of Repaired System Prior to System Restart
- Re-filling and Adding Fluid to System Reservoir
- Pre-filling/Cleaning Hydraulic Systems:
  - **New Equipment**
  - **Re-built Equipment**



# Bulk Fluid Filtration – 3K9

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Industry**



## Features and Benefits

- Three patent-pending K9 filters supplied in series as a single filter assembly providing in-line single pass particulate and water filtration
- Meets HF4 automotive standard
- 900 psi rating covers almost all transfer line pressure specs including air driven transfer systems
- Top loading for easy access for element change out
- Allows consolidation of inventoried elements by using K-size elements
- Can be fitted with test points for oil sampling



# Bulk Fluid Filtration – Desiccant Air Breather



**Contamination  
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for the  
Refuse  
Industry**



## Features and Benefits

- Unique air flow design with suction tube as splash protection and protection against absorbent getting into the tank
- 2 stages of absorbent provide optimal combination of drying efficiency and water retention
- Pleated air filter with 2  $\mu\text{m}$  filtration rating
- Reusable base with check (intake) and bypass (outflow) valves
- Check valves prevent absorbents being saturated during system downtime
- Bypass valves divert out flow away from water removal media to preserve its life
- Robust Zinc die-casting connection piece with integrated anti-splash baffles
- Replacement cartridge available in 3 different sizes





**Schroeder Industries**  
**Your Contamination Control**  
**Partner**