2012 台灣氧氣使用安全國際研討會

Oxygen Safety Seminar 2012 Taiwan

行政院勞工委員會

台灣區高壓氣體工業同業公會

Asia Industrial Gases Association

國立臺北科技大學

Cleaning and Inspection for Oxygen Service

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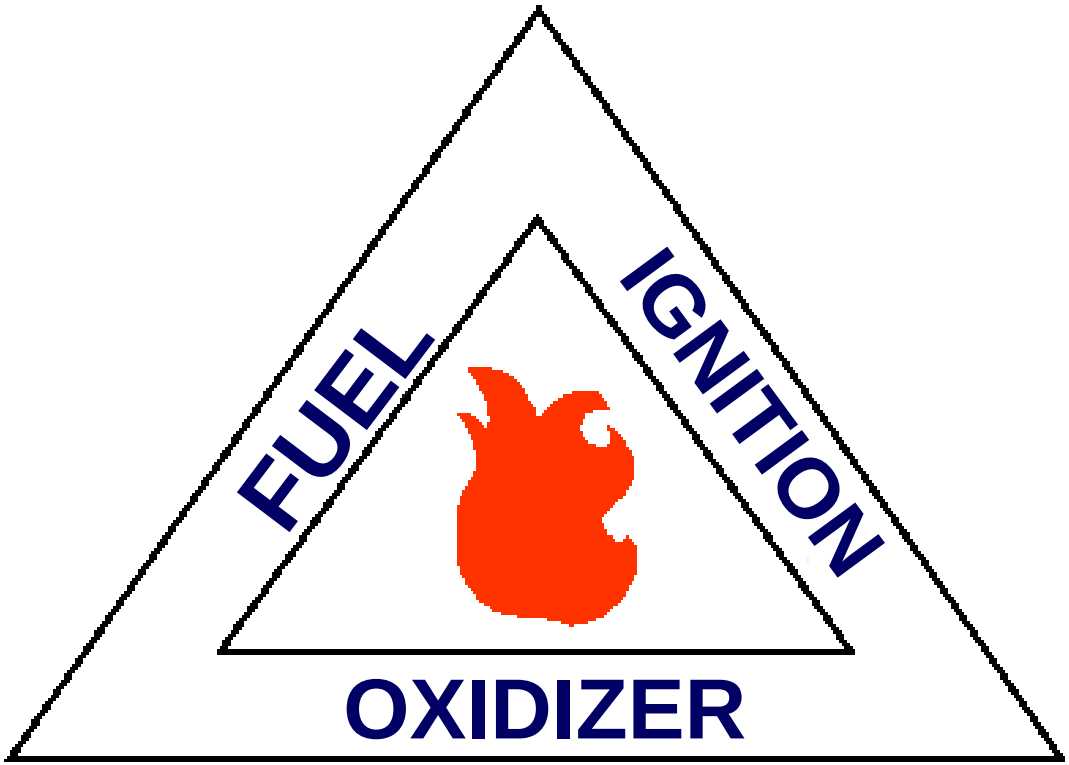
Michael Lin joined Air Products in 2004 and is currently the *Regional Manager of Customer Engineering Asia*
He has been working with oxygen system installations and maintenance activities for customer stations since 2004.

Michael graduated in 1986 from Chiao Tung University with a master degree in Mechanical Engineering.

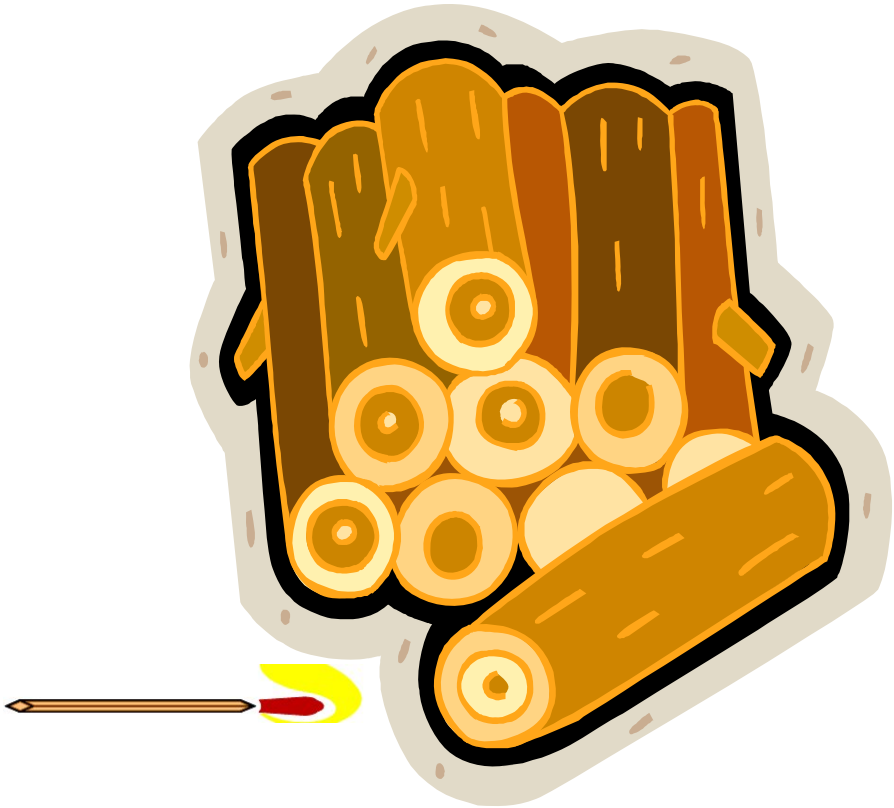
Fire Triangle



Material selection vs. **O2 Compatibility**

- Oxygen Compatible $\neq$ Does not burn
- Oxygen compatibility means that the designer has selected a material which is good (or at least not bad) for use in oxygen at the conditions anticipated.
- Normally this means hard to ignite.

Making a fire



The kindling chain

The small stuff

Unintentional, not meant to be there

Hydrocarbons

- Grease, Cutting Oil, Crayon, Residual cleaning agents

Threads and fibres

- Rags, Cloths

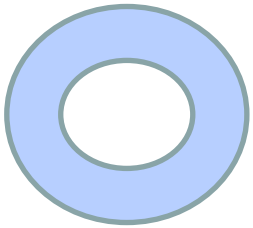
Particulates

- Rust, mill scale, welding slag

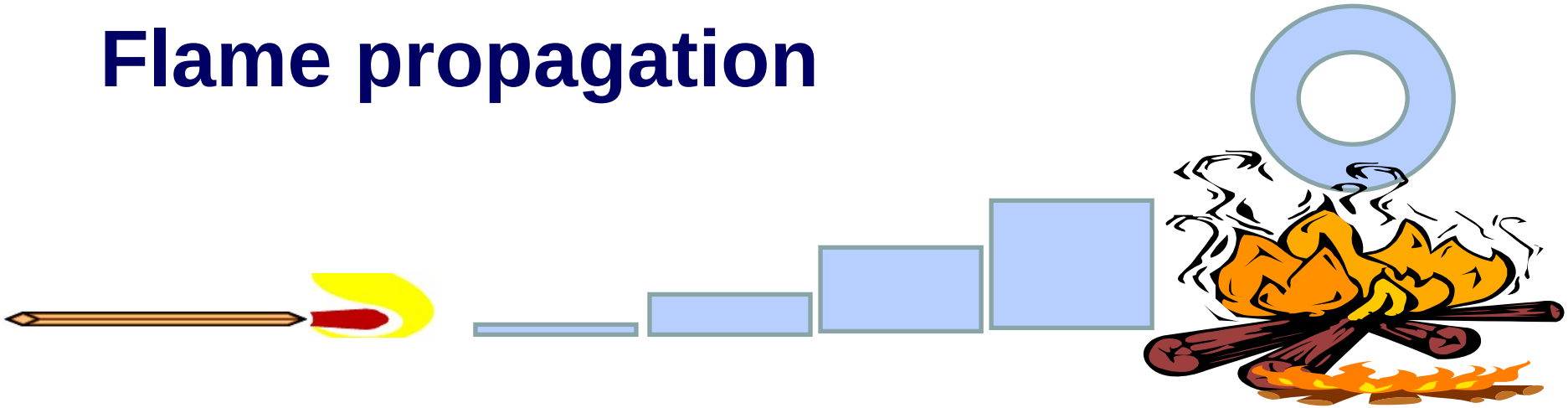
Thin stuff used without **thought**

- Filter material
- Sharp edges on valves or fittings
- Soft-goods like seals and seats, hose inners

How much hydrocarbon is acceptable?



Flame propagation



The type hydrocarbon

The oxidiser strength

The oxidiser pressure and temperature

The geometry (up, down, sideways)

and of course the thickness of the hydrocarbon

Acceptance Criteria

	Values in mg/m²
NASA	10 to 40
ASTM	10 to 550
EIGA	<30bar = 500
	>30bar = 200
CGA	500
ISO15001	<30bar = 220
	>30bar = 550

How much is 200mg/m2

A drop is about 20 to 50 mg of oil.

So between 4 to 10 drops

= 200mg for 1m^2

OK so we are all suitably scared?

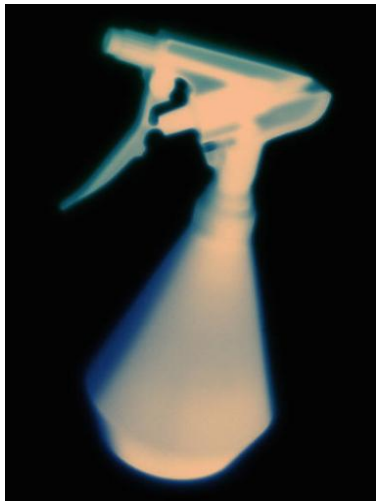
Cleaning - Two basic methods

Mechanical / Physical

Rubbing things with rags or brushes

Chemical

Dissolve the contamination with chemicals



Cleaning methods

Water Based	pH Based	Solvent	Mechanical
Soapy detergents	Alkali Hot dip	Liquid solvents	Ultrasonic Vapour solvents
Steam cleaning		Swabs for spot cleaning	Abrasive Sandblasting Wire Brushes Tumbling
Hot water	Acid Dip, or flush	Flushing	Pigs in pipes
			Blowing

Buy it clean vs. Field cleaning

Field cleaning is:

- hard to do
- expensive
- not very effective

So much easier to buy things clean,
keep them carefully bagged till you want to use them,
and then be careful about not getting the dirty.

Practical Field cleaning

- **Spot cleaning with solvents**
- **Rubbing or blasting**
  - Using pigs in pipes
  - Using wire brushes to remove rust
  - Using shot blasting
- **Washing in detergents**

In the field ONLY clean the parts needed

- **Use your intelligence**
  - The rest of the system is already clean
  - Be careful not to get it dirty
  - Clean only the part before assembly

- **Do not install a dirty part and make your work harder – you will have to clean the whole thing**
  - Expensive,
  - Takes long time
  - Generally does not work…

Solvents in field cleaning

- Environmental legislation
- Residuals
- Hazards
- Possible products are

  - Acetone, Isopropyl alcohol, trichloroethylene, 3M 72DE, Sitosec, Leksol TM & Leksol AG101

Shot blasting and rubbing

Water based detergents

- What detergent to use?
- What are the practicalities?
- What are the limitations?

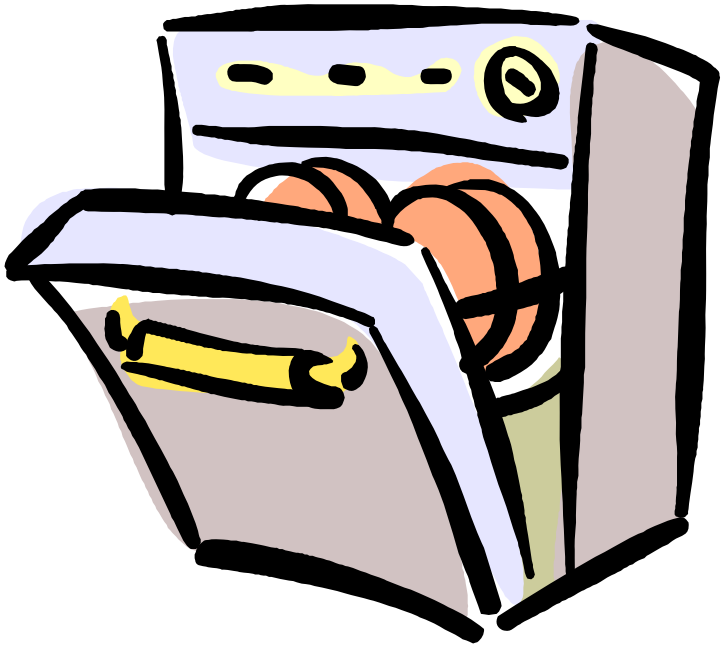
Basics

- Freshness
- Temperature
- Agitation
- Soaking/ softening
- Rinsing
- Drying

Detergents are Flammable

- **The detergents used are not compatible for actual oxidizer service.**
  Therefore, all residues must be thoroughly rinsed away**.**
- **Potable water should be the minimum quality of water used and it can be applied in the same way as the detergent solution was used: immersion, spraying, pump through.**

Dishwasher machines



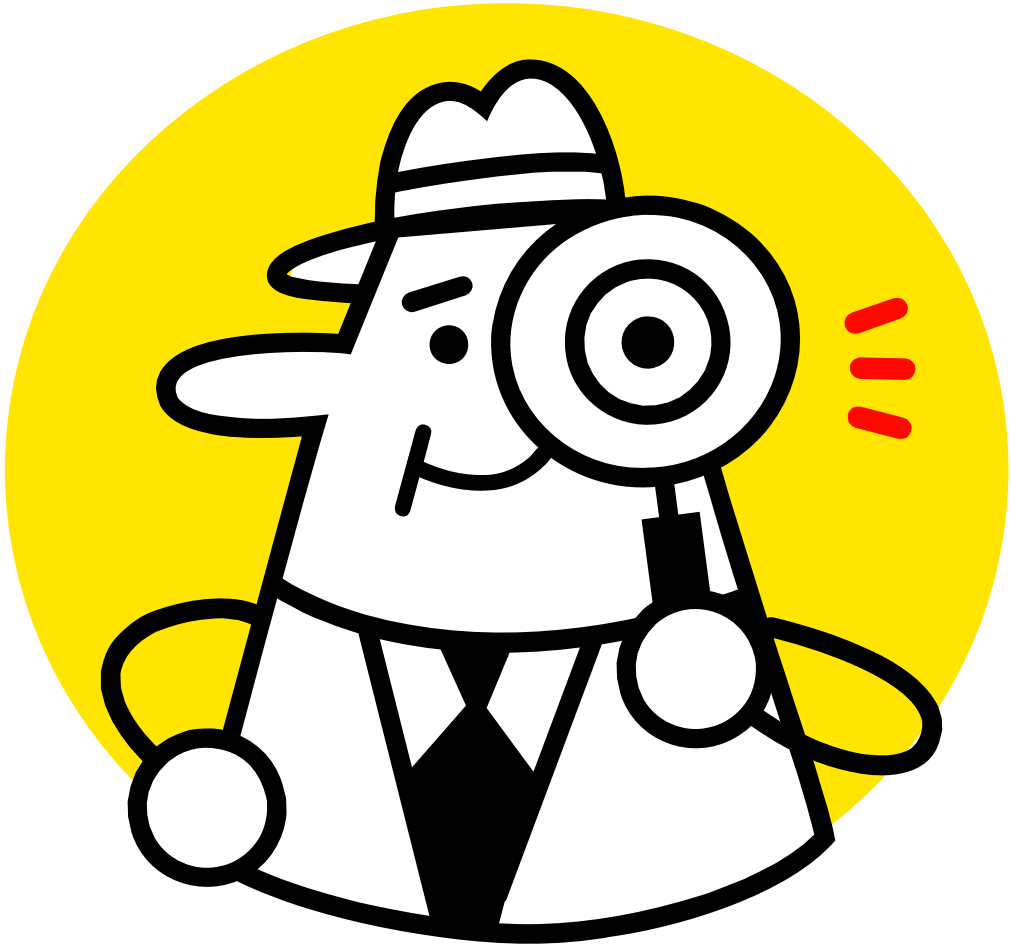
EIGA/AIGA & Supplier recommendations

- EIGA/AIGA is not in the market of selling or recommending detergents

  EIGA/AIGA
- What follows is information only, the user needs to check with the manufacturer to select the best product for their cleaning task

Detergents

Post cleaning inspection



How much oil is acceptable

200mg/m^2 for >30bar

500mg/m^2 for <30bar

Methods of inspection

Visual + Black-light

Inspection methods (continued)

The wipe test

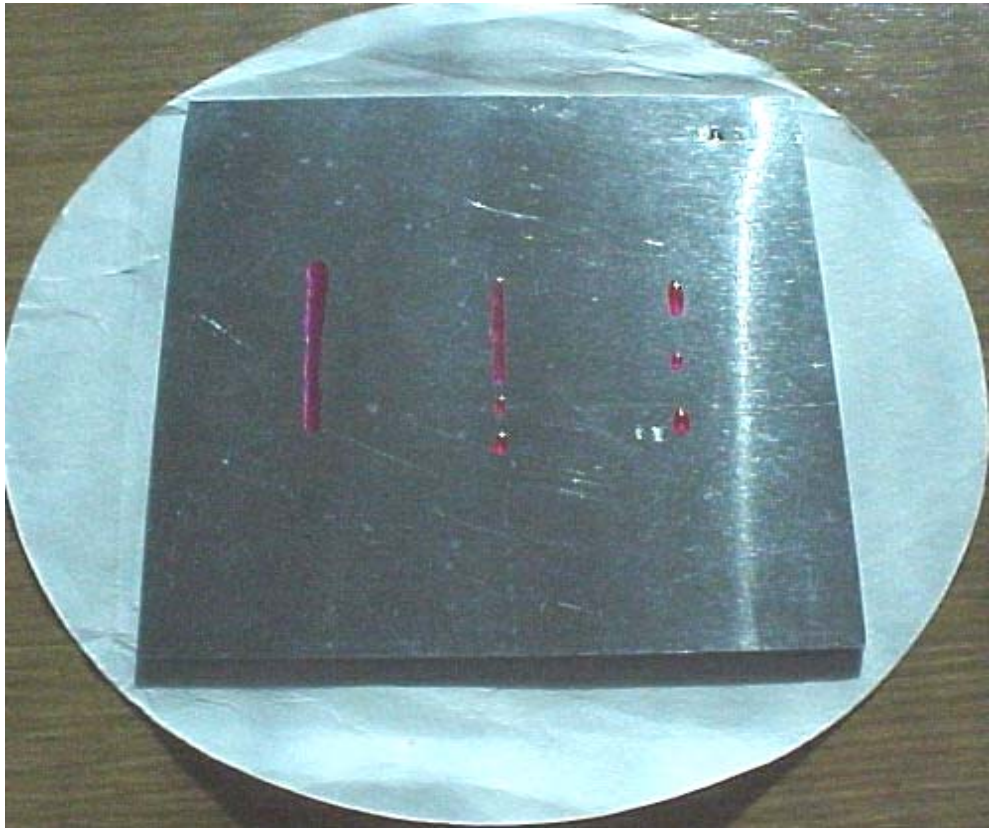
Solvent Flush

Water break test

Water on hydrocarbon

Water with no hydrocarbon

Inks and the water break test



Inspection using one‘s EYES

Visual **then** **Black-light**

White light inspection

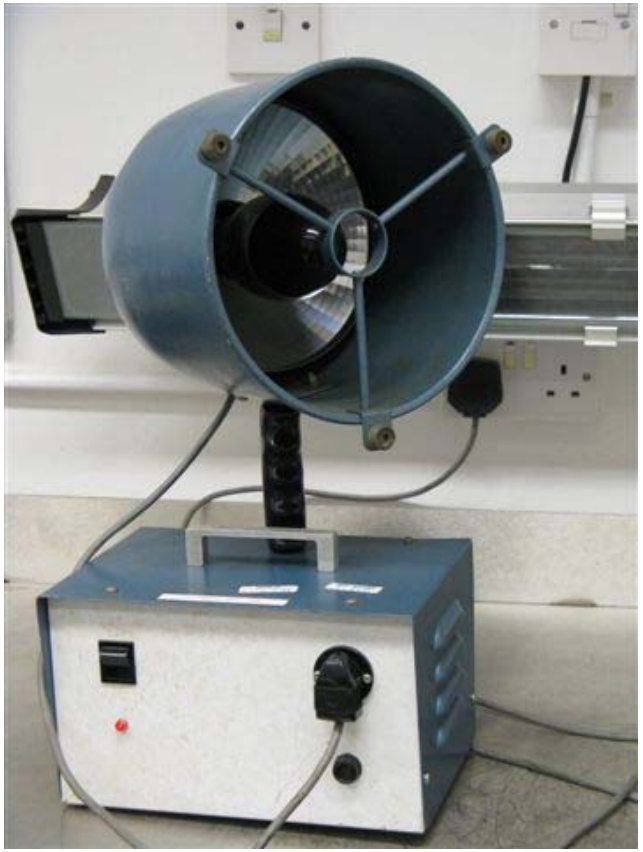
Depends upon:

- Eyesight
- Light intensity

Fooled by:

- Shiny surfaces = false positive
- Reflections = false positive
- Rough surfaces = false negative

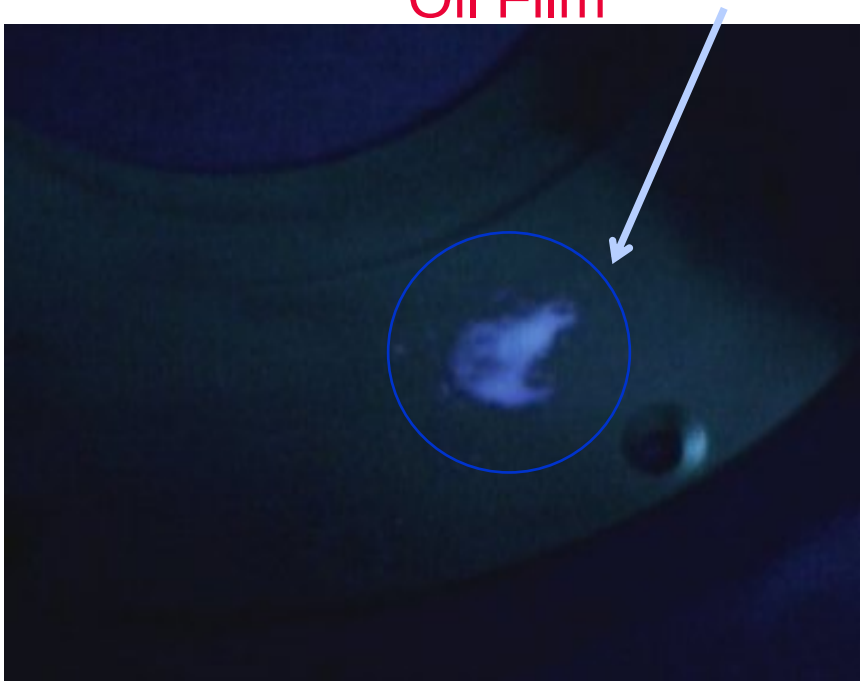
Black light – incandescent bulb models



Black (UV) light inspection

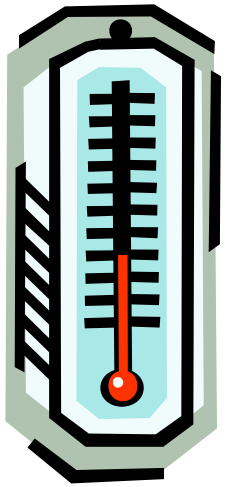
Oil Film

Fluorescence of Oil Film



but not all oils fluoresce

Black light – practicalities

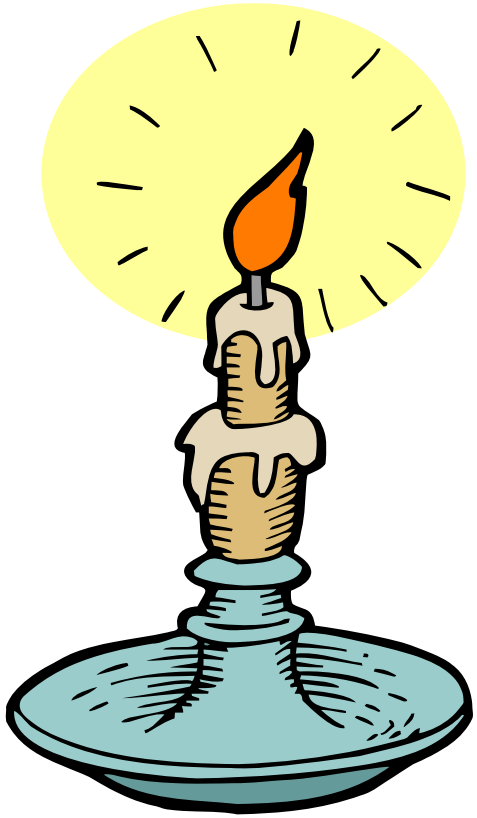


HOT

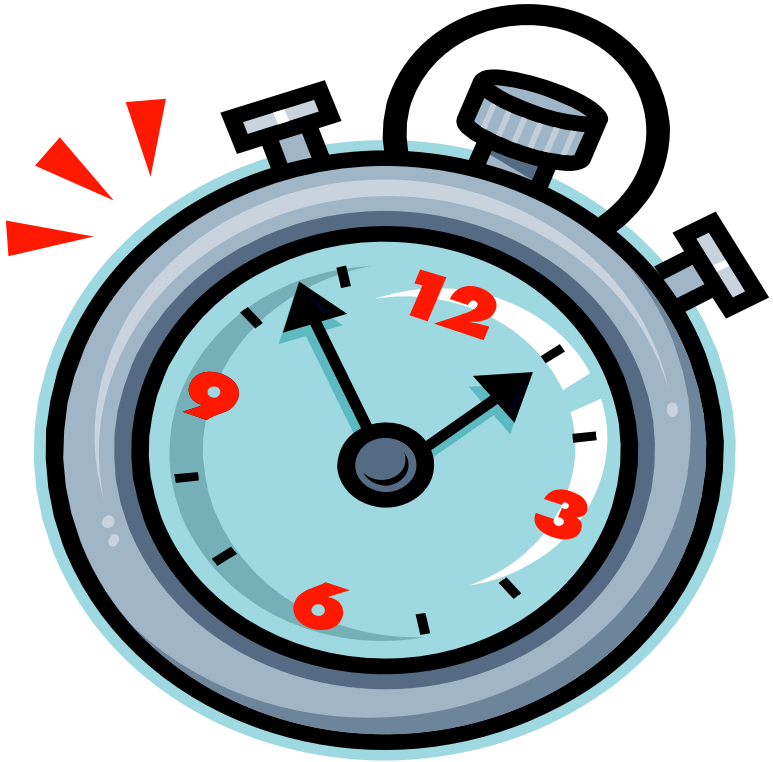
BREAK

HAZARDOUS LIGHT

Black light – effectiveness



Black light – time



3 to 4 minutes

Black light – alternates

4W

300-500 mm

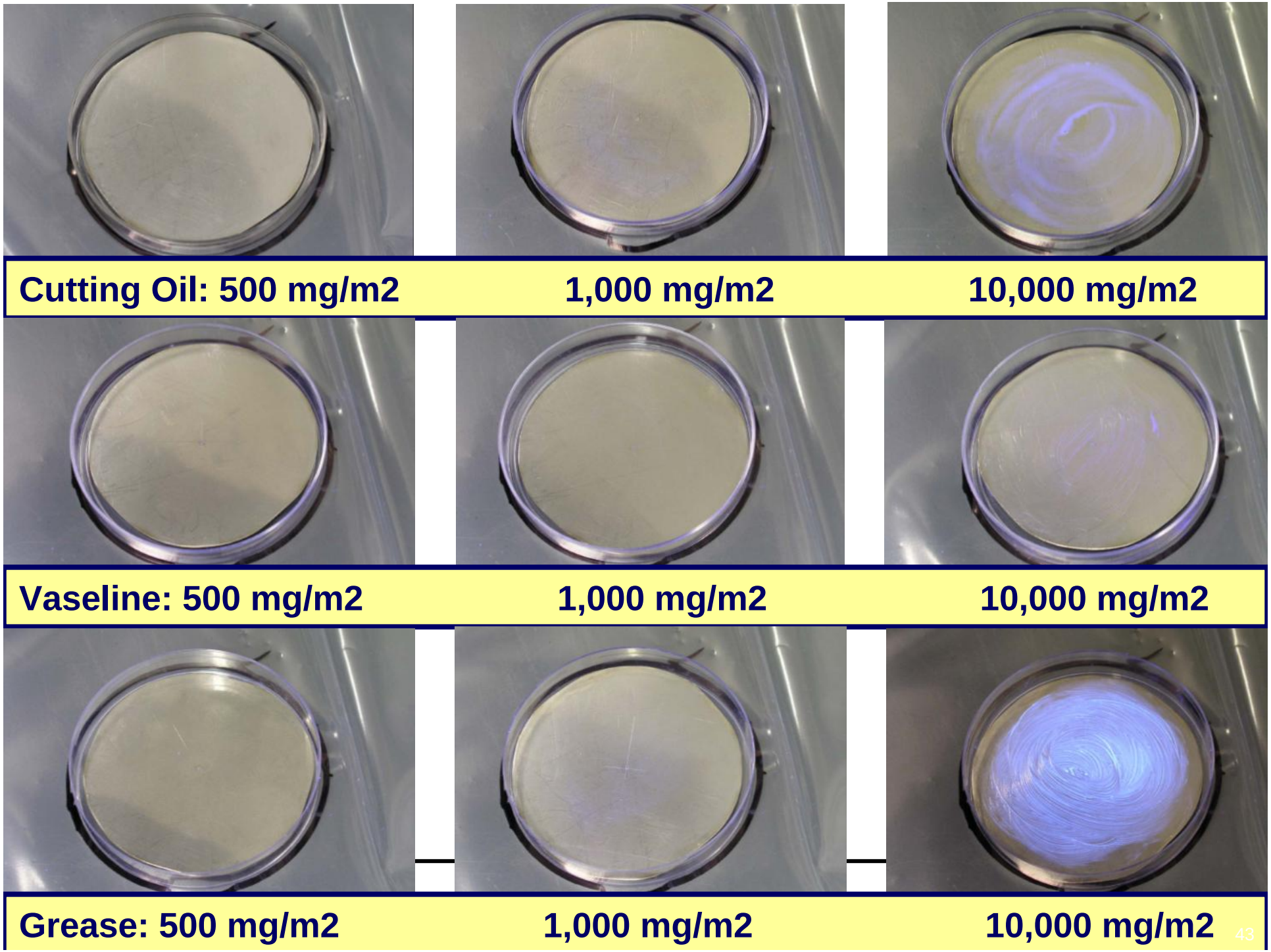
Desktop lamp used in laboratory

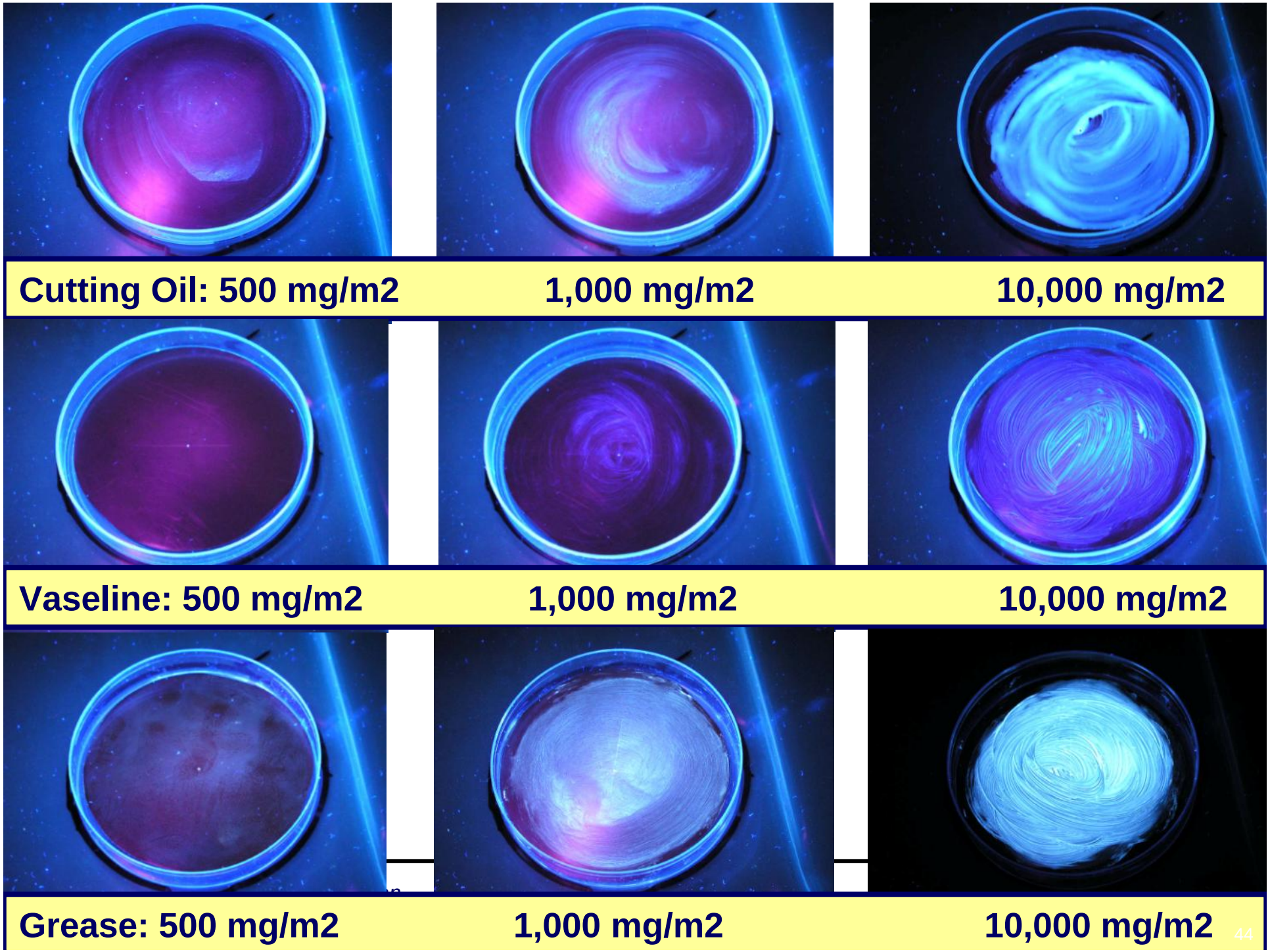
1W

What is the detection capability

Method	Mobil Rarus 57 (mg/m^2)	Mobil DTE Medium (mg/m^2)	Mobil DTE Heavy Medium (mg/m^2)
White light	1042	1829	1195
UV light	45	694	1441
Wipe test	30	168	611
Water break test	60	45	43

Gilbertson and Lowrie, ASTM STP 910, pp. 204-11.


Cutting Oil: 500 mg/m2
1,000 mg/m2
10,000 mg/m2
Vaseline: 500 mg/m2
1,000 mg/m2
10,000 mg/m2
Grease: 500 mg/m2
1,000 mg/m2
10,000 mg/m2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10,000 mg/m2
Grease: 500 mg/m2
1,000 mg/m2
10,000 mg/m2

How much oil is acceptable

200mg/m^2 for >30bar

500mg/m^2 for <30bar

Practical acceptable inspection criteria

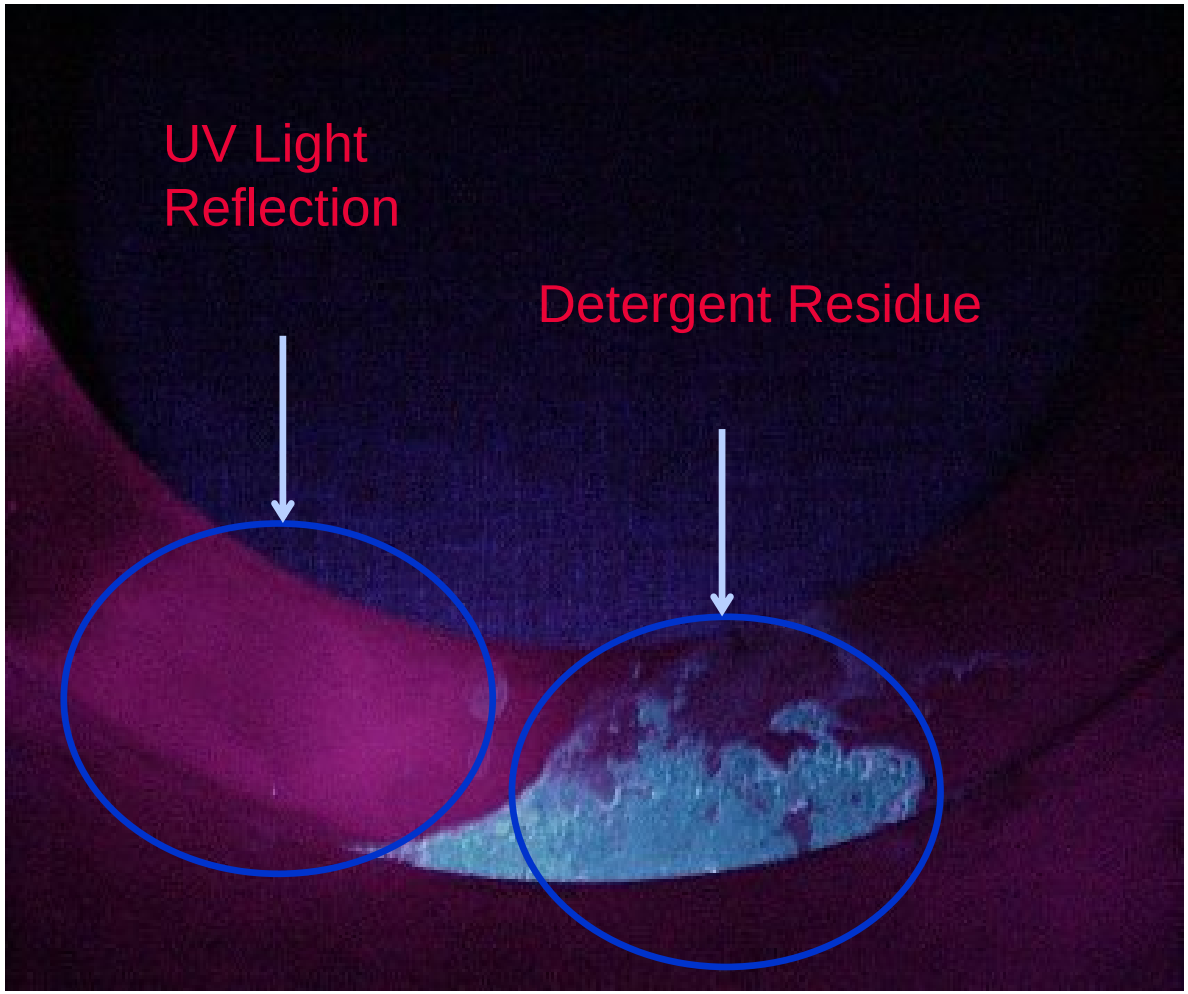
White and Black Light Inspection shall indicate:

No moisture

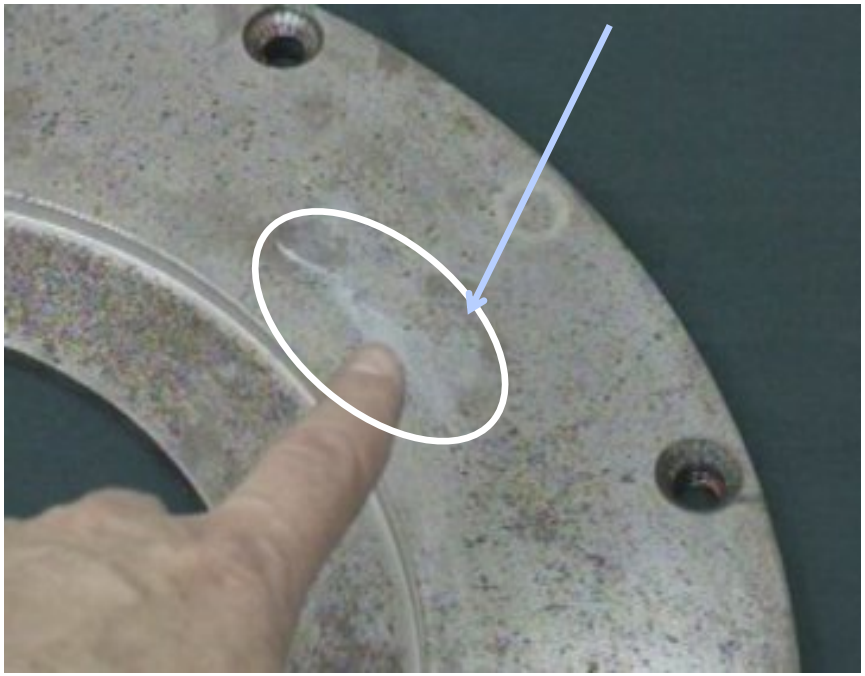
- No cleaning agents
- No particulate
- No paint, crayon, etc.
- No hydrocarbon or organic oils, greases, adhesives, etc.
- No excessive accumulations of even approved substances

NOTHING shall be seen

NOT 1 THING


UV Light
Reflection
Detergent Residue

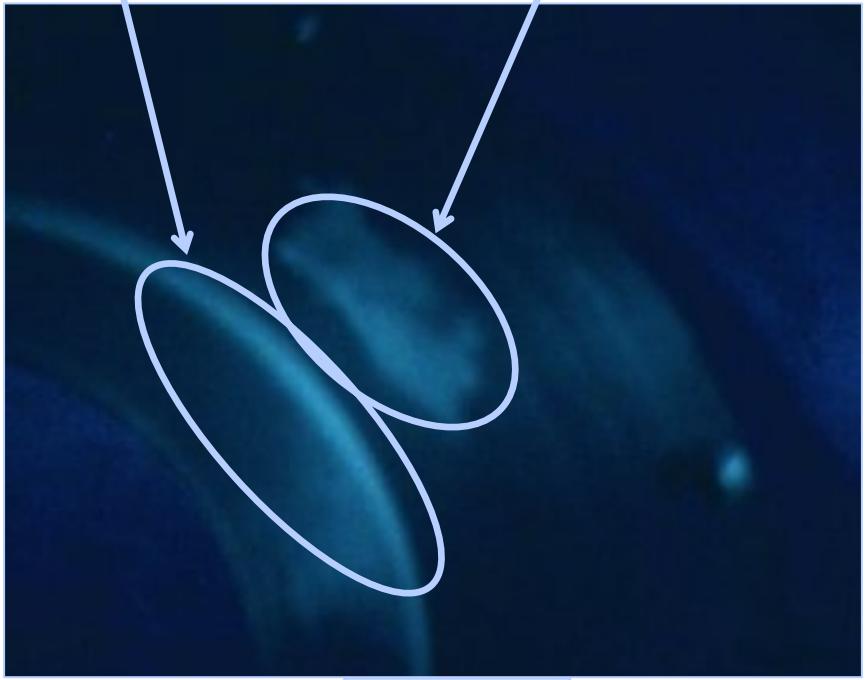
Fluorescence of Oxidizer Compatible Grease



White Light

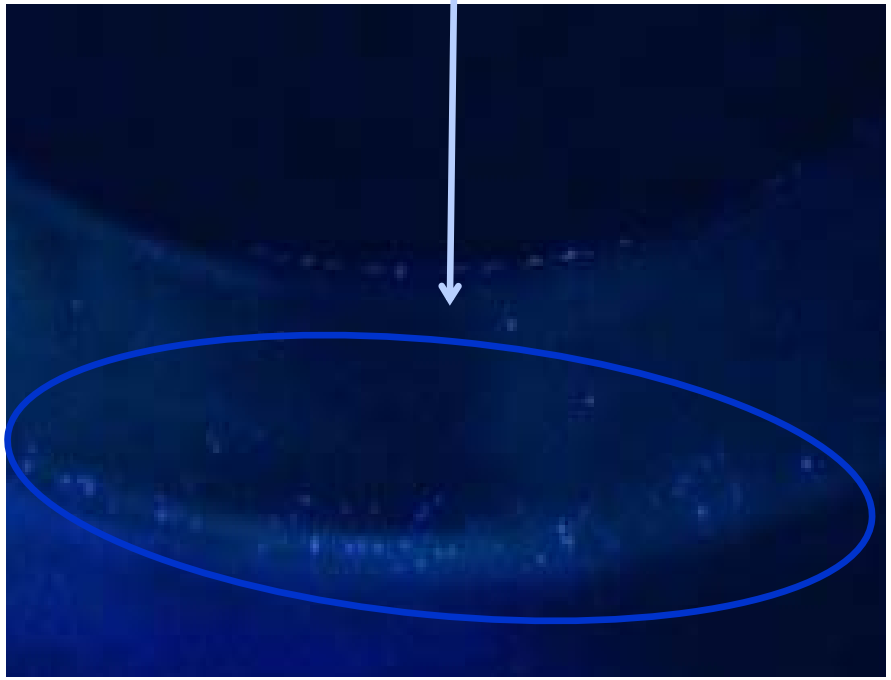
Reflection

Fluorescence of Oxidizer Compatible Grease



UV Light

Threads, Particulates & Lint

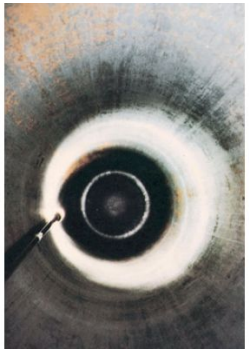


Rust

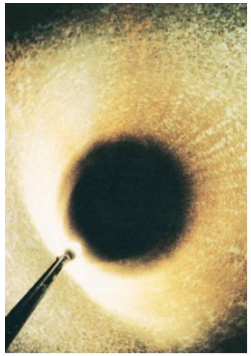
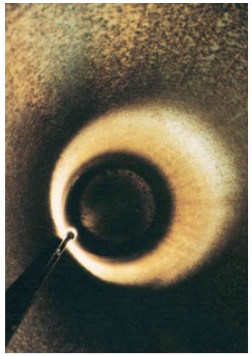
Acceptable Rust

Not Acceptable Rust

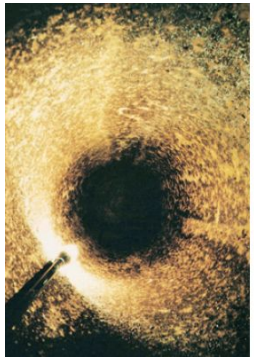
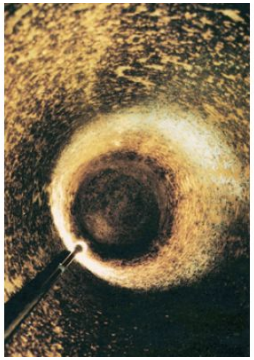
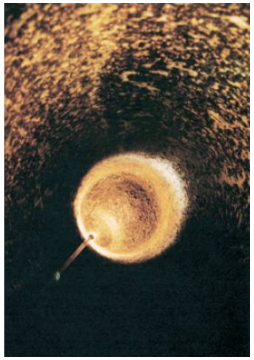
Rust and cylinders


As new

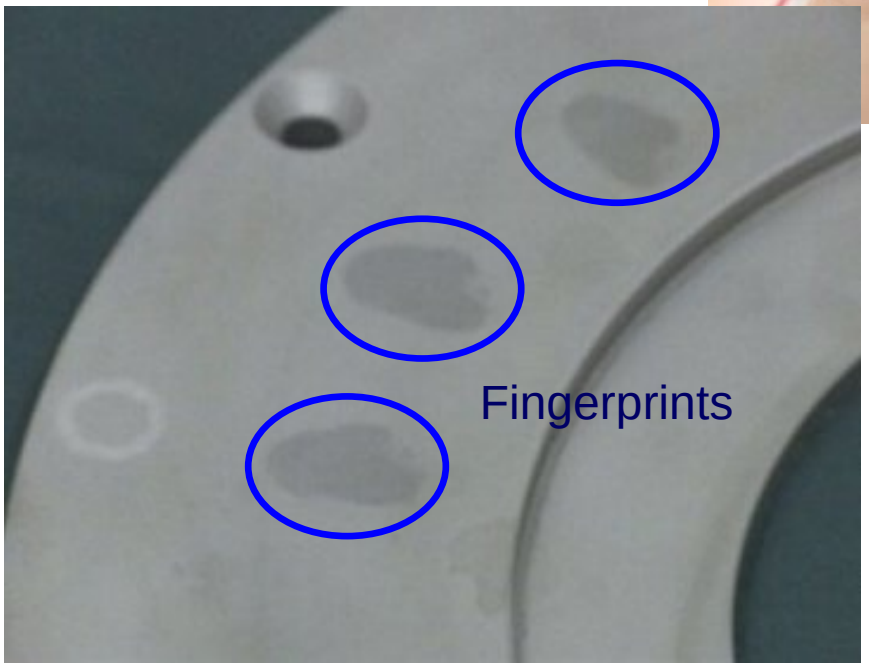




Light pitting which is acceptable

Heavy pitting that would require shotblasting before further visual inspection

Fingerprints



White Light

UV Light

Post cleaning protection

Conclusion

- Contamination is often the root of the fire, the base of the kindling chain

- The amount of hydrocarbon required to start a fire is remarkably small
- Cleaning stuff in the field is harder to do than buying it clean
- Inspection of cleanliness is limited, and due to the limitation the rule must be “see anything and you have to clean again”

Thank you

Original Presentation by
Daniel Tregear (Air Products)
at EIGA 2012 Meeting

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