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

氧氣服務系統的清潔與檢查

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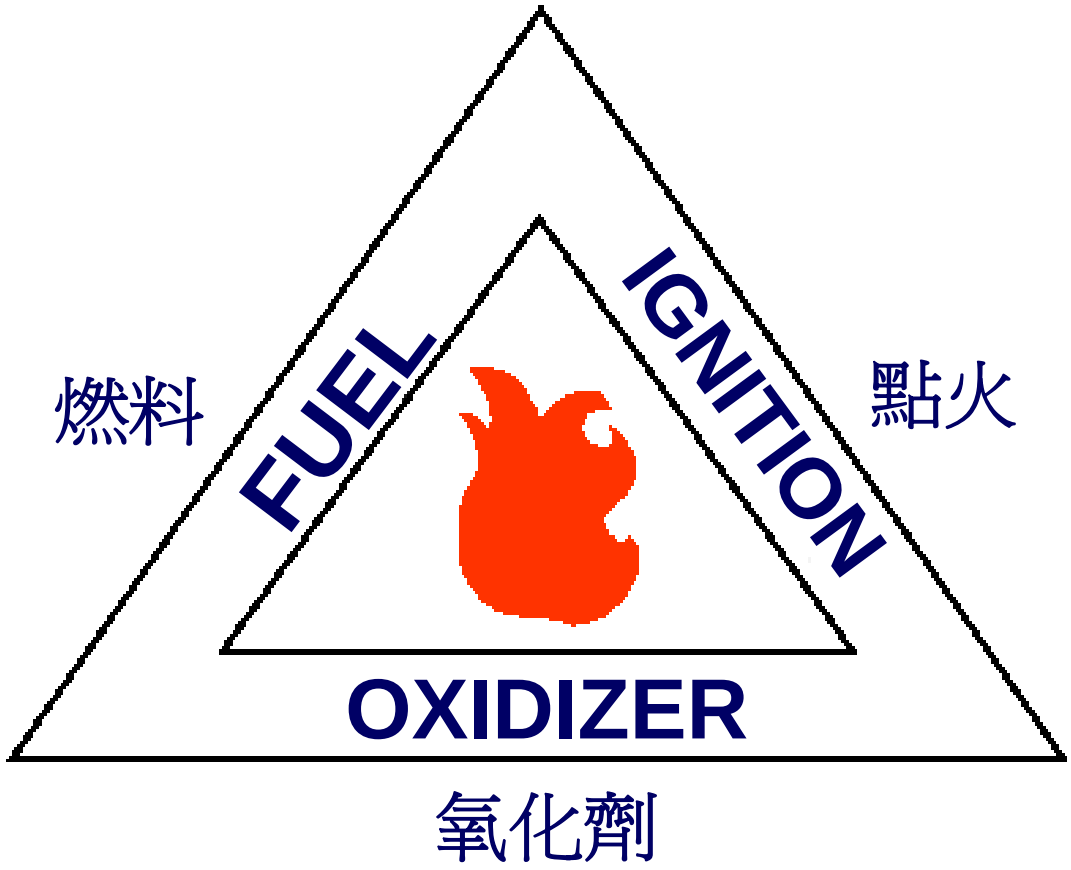
Michael graduated in 1986 from Chiao Tung University with a master degree in Mechanical Engineering.

Fire Triangle 火的形成三要素



Material selection vs. **O2 Compatibility**

材料選擇與氧氣相容性

- Oxygen Compatible $\neq$ Does not burn

  氧氣相容不等於'不會燃燒'

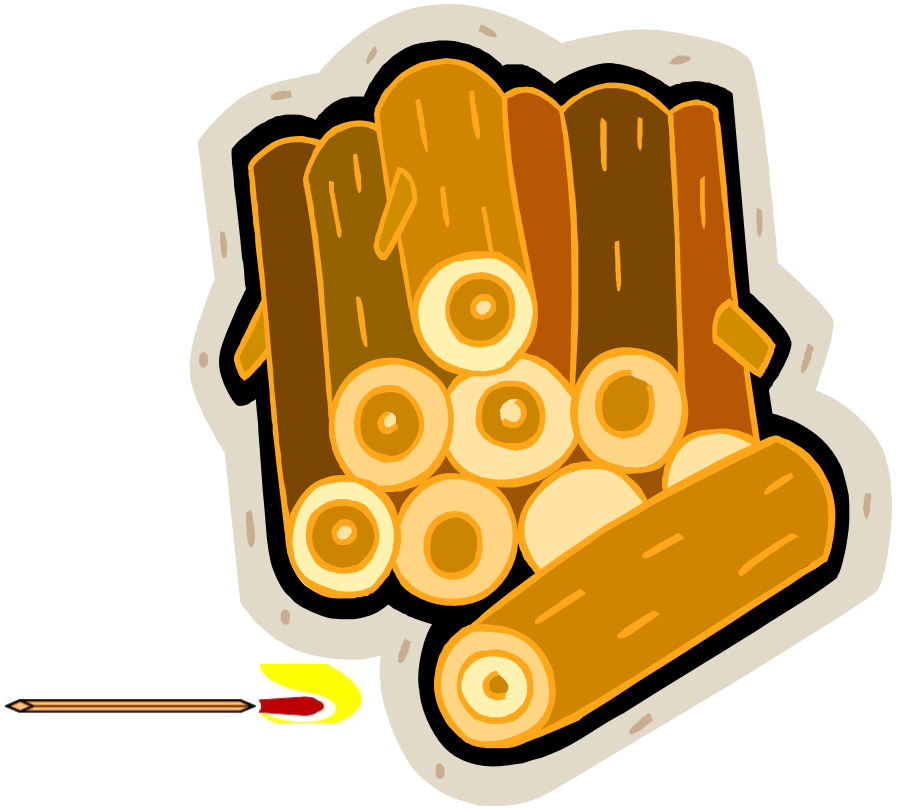
- Oxygen compatibility means that the designer has selected a material which is good (or at least not bad) for use in oxygen at the conditions anticipated.

  氧氣相容性是指在預期操作狀況下所選用的材料是合適用於氧氣系統

- Normally this means hard to ignite.

  通常，這表示較不易燃燒起來

Making a fire 點燃一道火



The kindling chain 引火煉效應

The small stuff 小小殘留物

Unintentional, not meant to be there 非故意的, 不該殘存的

Hydrocarbons 碳氫化合物

- Grease, Cutting Oil, Crayon, Residual cleaning agents
  潤滑油, 切削油, 蠟筆, 殘留清洗劑

Threads and fibres 細線和纖維

- Rags, Cloths 破布, 衣服

Particulates 顆粒

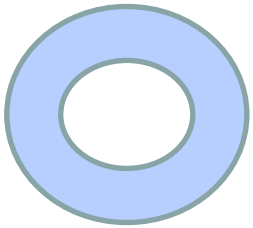
- Rust, mill scale, welding slag 生鏽, 車削薄片, 焊渣

Thin stuff used without **thought** 未經仔細思考的薄片殘留物

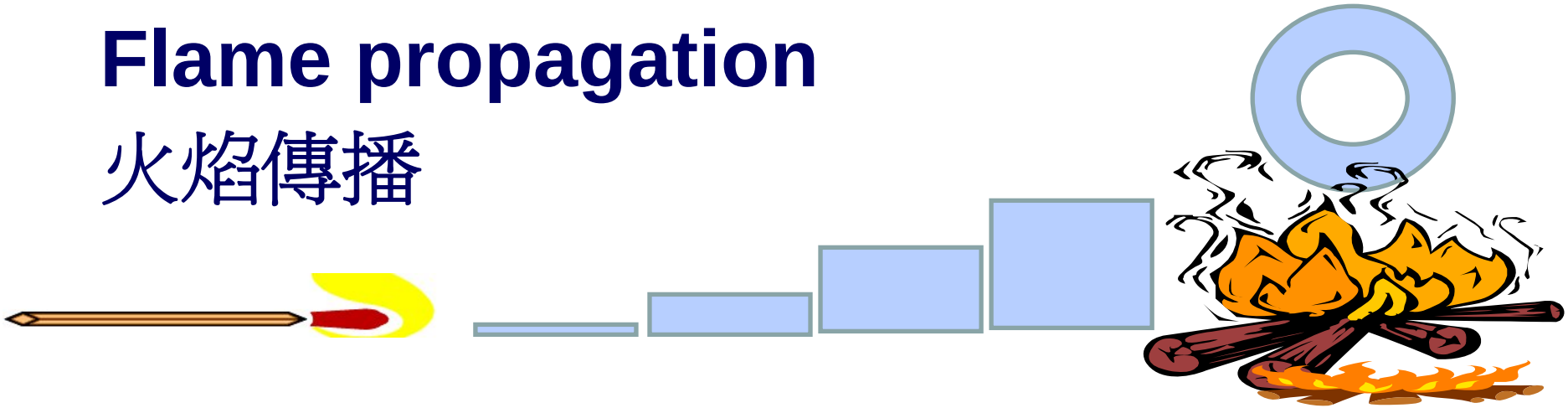
- Filter material 過濾器材料
- Sharp edges on valves or fittings 閥門或配件上的尖銳邊緣
- Soft-goods like seals and seats, hose inners
  軟性物質, 像是密封墊, 閥座, 軟管內部

How much hydrocarbon is acceptable?

多少量的碳氫化合物是可以被接受的?



Flame propagation
火焰傳播



The type hydrocarbon 碳氫化合物的形式

The oxidiser strength 氧化劑的強度

The oxidiser pressure and temperature

氧化劑的壓力與溫度

The geometry (up, down, sideways) 幾何形狀

and of course the thickness of the hydrocarbon

以及也必須要考慮到碳氫化合物的厚度

Acceptance Criteria 可接受的標準

	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
每平方公尺200毫克是指多少量

A drop is about 20 to 50 mg of oil.

So between 4 to 10 drops

= 200mg for 1m^2

4大滴或**10**小滴的油脂分布在**1**平方公尺

OK so we are all suitably scared?

因此, 我們該被嚇到嗎?

Cleaning - Two basic methods

氧氣清潔 – 兩種基本的方法

Mechanical / Physical
機械性的/物理性的

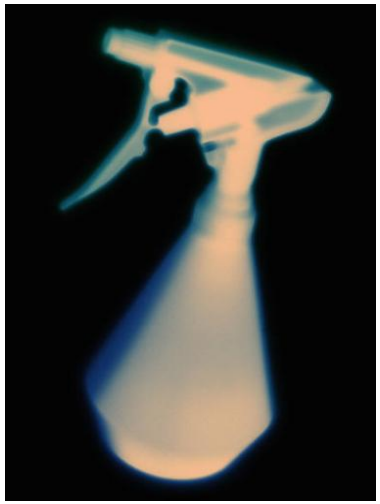
Rubbing things with rags or brushes

用破布或刷子擦拭

Chemical
化學性的

Dissolve the contamination with chemicals

用化學品將汙染物溶解



Cleaning methods 氧氣清潔的方法

Water Based 水溶液	pH Based 酸鹼溶液	Solvent 溶劑	Mechanical 機械性的
Soapy detergents 肥皂泡清潔劑	Alkali Hot dip 在鹼性溶液中熱浸泡	Liquid solvents 液態溶劑 Swabs for spot cleaning 局部清潔的擦洗 Flushing 沖洗	Ultrasonic Vapour solvents 超音波設備中放入溶劑
Steam cleaning 蒸氣清潔			Abrasive Sandblasting 噴砂 Wire Brushes Tumbling 金屬刷滾動
Hot water 熱水	Acid Dip, or flush 在酸性溶液中浸泡, 或沖洗		Pigs in pipes 管豬
			Blowing 吹掃

Buy it clean vs. Field cleaning

購入已完成氧氣清潔 **vs.** 在現場作氧氣清潔

Field cleaning is: 在現場作氧氣清潔是:

- hard to do 執行上較困難的
- expensive 成本較高的
- not very effective 不是很有效的

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.

購入已完成氧氣清潔是比較容易的做法, 直到使用前把閥件裝在袋子內, 小心保存清潔, 不要讓它被汙染

Practical Field cleaning

在現場實地作氧氣清潔

- **Spot cleaning with solvents**
  使用溶劑做局部氧氣清潔
- **Rubbing or blasting**
  摩擦或噴砂
  - Using pigs in pipes 使用管豬
  - Using wire brushes to remove rust 使用金屬刷除銹
  - Using shot blasting 使用噴砂
- **Washing in detergents**
  在清潔劑中清洗

In the field ONLY clean the parts needed

在現場只對需要的閥件作氧氣清潔

- **Use your intelligence 要事先計劃好**
  - The rest of the system is already clean 大部分都是清潔的
  - Be careful not to get it dirty 不要把閥件弄髒
  - Clean only the part before assembly 在連接前要將閥件清潔

- **Do not install a dirty part and make your work harder – you will have to clean the whole thing**

  不要在現場連接一個髒的閥件, 會把情況弄得更糟 – 必須把整個連接組件重新做清潔
  - Expensive, 成本很高的
  - Takes long time 花很多時間的
  - Generally does not work… 通常是很困難的

Solvents in field cleaning

在現場作氧氣清潔 所使用的溶劑

- **Environmental legislation 環保法規**
- **Residuals 殘留物**
- **Hazards 危害**
- **Possible products are 可以使用的溶劑有**

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

  丙酮, 異丙醇, 三氯乙烯, 3M 72DE,氣溶膠清洗液, 正丙基溴清洗液

Shot blasting and rubbing
噴砂和摩擦

Water based detergents 水基清洗劑

- What detergent to use?
  有哪些清洗劑可以使用?
- What are the practicalities?
  如何使用?
- What are the limitations?
  有哪些限制?

Basics 基本要素

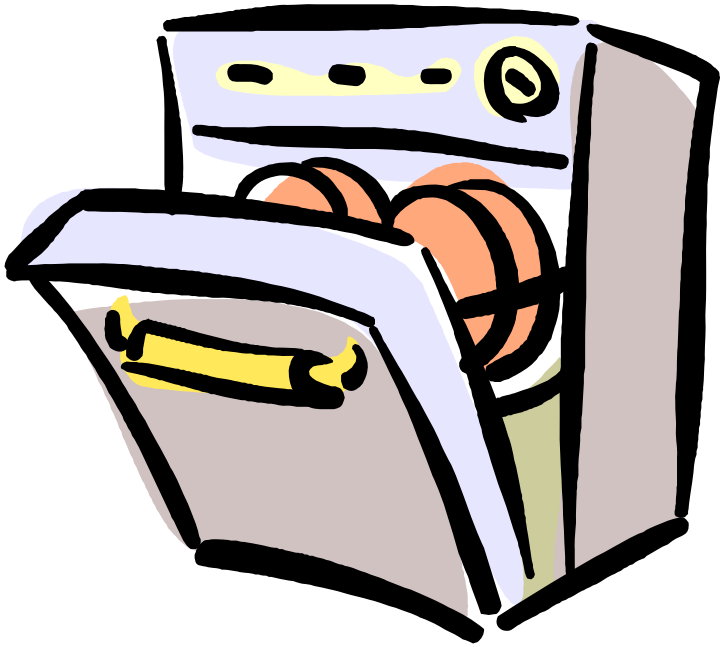
- Freshness
  是否回收重複使用
- Temperature 溫度
- Agitation 擦拭
- Soaking/ softening
  浸泡
- Rinsing 洗清
- Drying 乾燥

Detergents are Flammable

清洗劑是可燃的

- **The detergents used are not compatible for actual oxidizer service.**
  所使用的清洗劑與實際氧化劑系統並非是相容的
  Therefore, all residues must be thoroughly rinsed away**.**
  因此, 所有殘留物必須徹底清洗乾淨
- **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.**
  使用飲用水等級的清水, 如同使用清洗劑的方法, 來洗清殘留物質

Dishwasher machines 洗碗機



可以考慮建置一個區域氧氣清潔中心, 安裝一個類似洗碗機一樣的設備, 一次做大量的管配件與閥件的氧氣清潔, 可減少所需的人力和時間

EIGA/AIGA & Supplier recommendations
EIGA/AIGA 以及供應商的推薦

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

  EIGA/AIGA 並不是在販賣或推薦清洗劑廠商
- What follows is information only, the user needs to check with the manufacturer to select the best product for their cleaning task

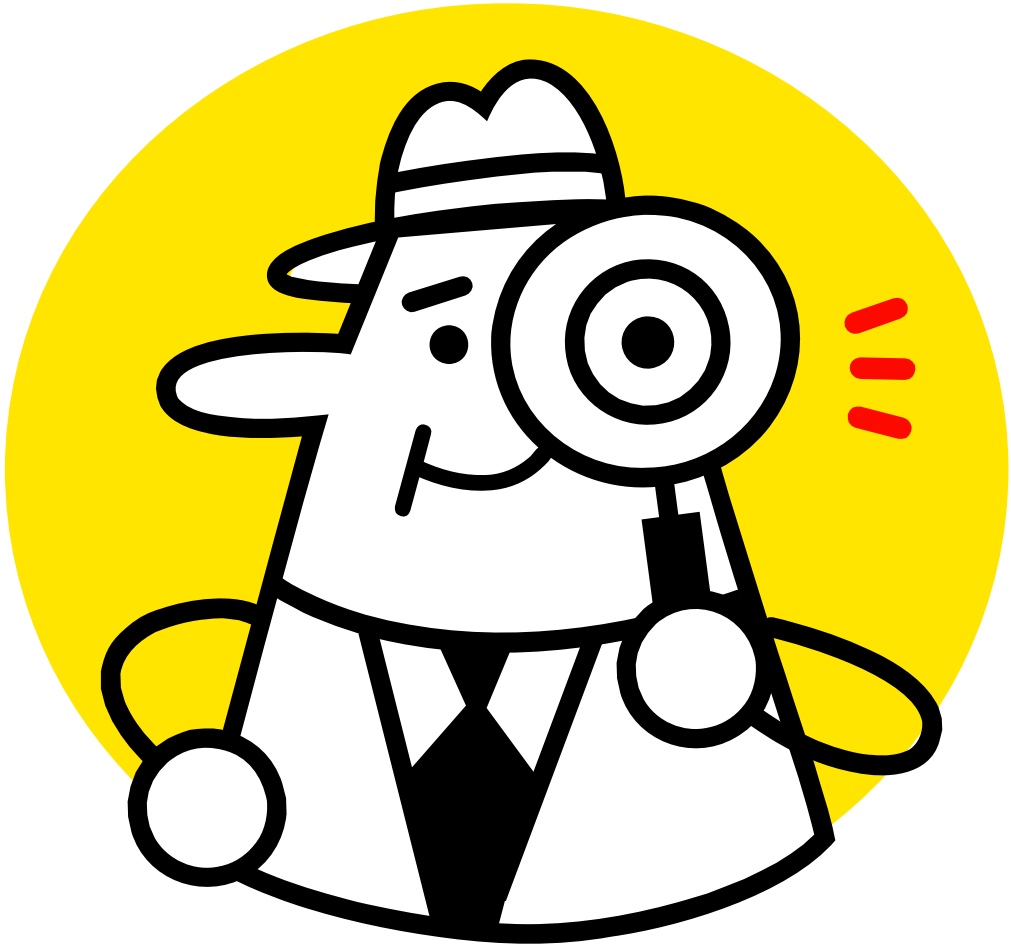
  以下訊息僅供參考, 使用者請聯絡製造商以選擇最合適其氧氣清潔的清洗劑

Detergents 清洗劑

考慮因素: 人工成本, 洗淨效果, 廢水排放, 清洗劑成本, 清洗溫度

Post cleaning inspection

氧氣清潔後的檢查



How much oil is acceptable

可接受油脂的量

200mg/m^2 for >30bar

500mg/m^2 for <30bar

Methods of inspection 檢查方法

Visual 目視 + Black-light 黑燈

Inspection methods (continued)檢查方法

The wipe test 擦拭測試

可用白色的布或紙擦拭, 尤其是眼睛看不到的地方

Solvent Flush 溶劑沖洗

溶劑流過後的色差比對,
或溶劑沖洗後的殘留物重量比對

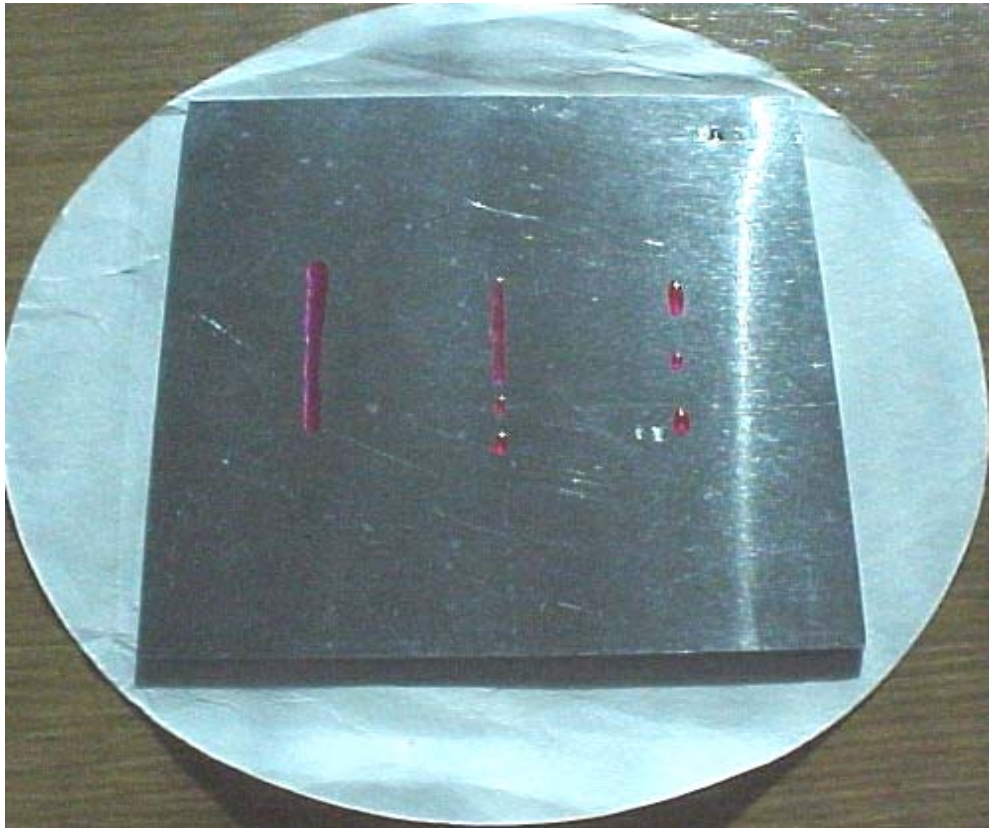
Water break test 水滴測試

Water on hydrocarbon
水在有碳氫汙染物質上

Water with no hydrocarbon
水在無碳氫汙染物質上

Inks and the water break test

染色水水滴測試



Inspection using one‘s EYES

使用眼睛檢查

Visual then Black-light

先目視然後使用黑燈

White light inspection 白燈檢查

Depends upon: 依據

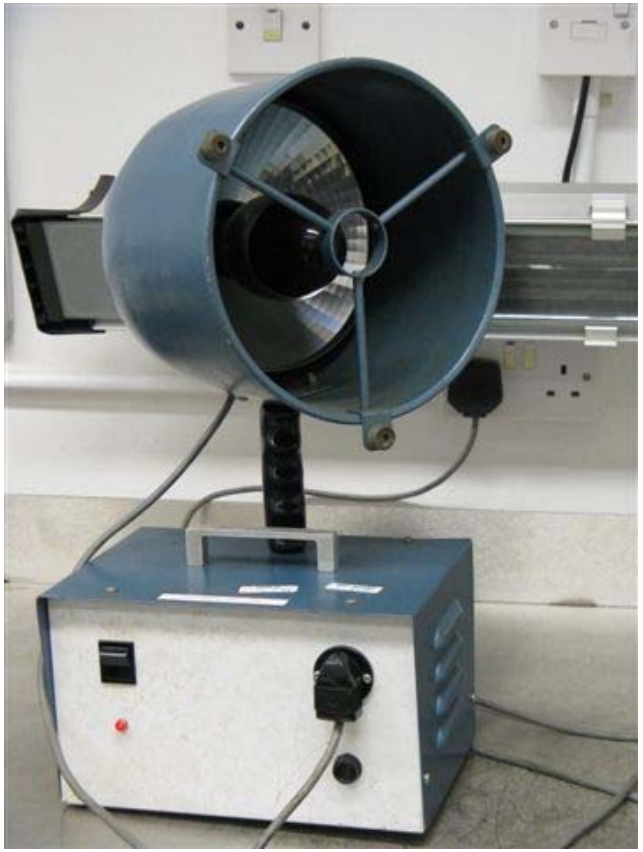
- Eyesight 視力
- Light intensity 光的強度

Fooled by: 被以下欺騙

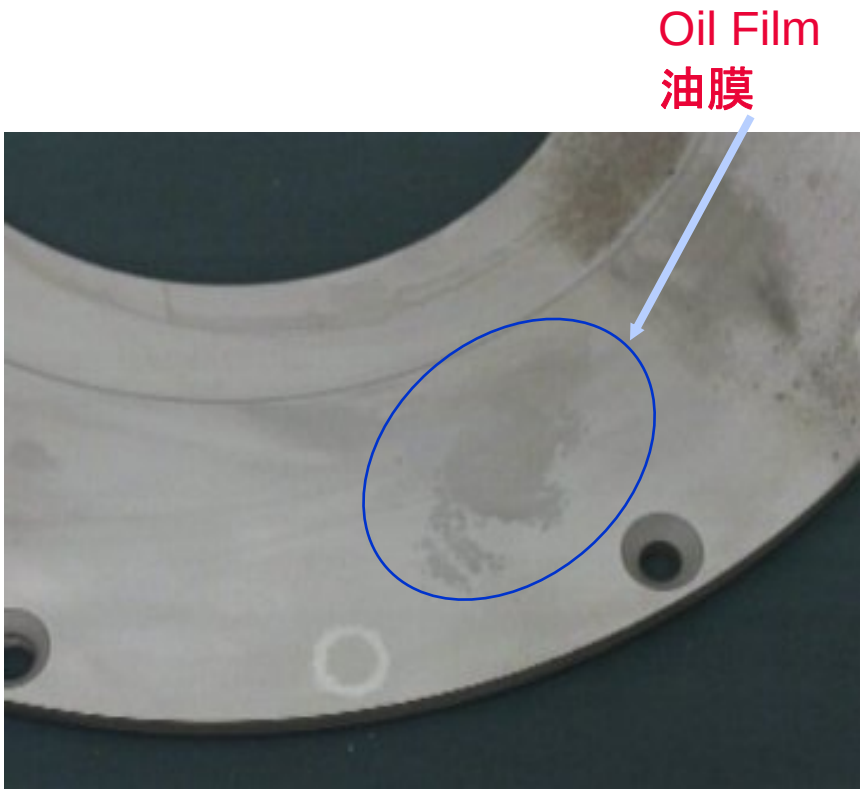
- Shiny surfaces = false positive
  光滑的表面 = 看起來較好
- Reflections = false positive
- 反射表面 =看起來較好
- Rough surfaces = false negative
  粗糙的表面 =看起來較差

Black light – incandescent bulb models

黑燈-熾熱燈泡型



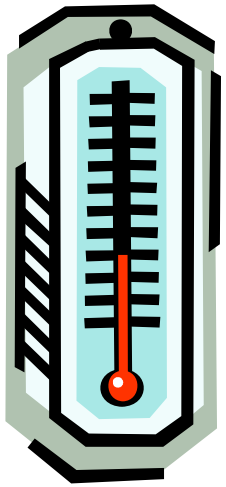
Black (UV) light inspection 黑燈檢查



but not all oils fluoresce

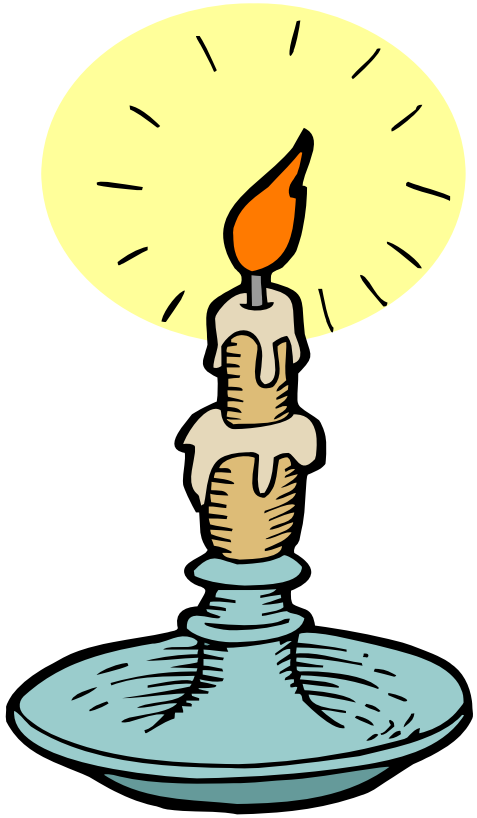
並非所有油膜都有螢光反應

Black light – practicalities 黑燈- 實務經驗



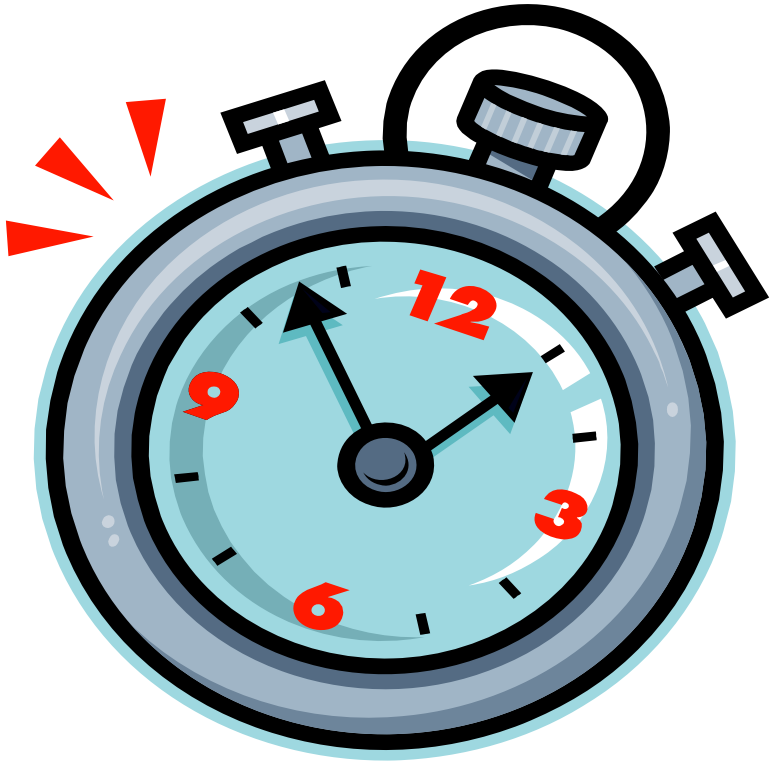
HOT (熱) **BREAK(燈泡易破)** **HAZARDOUS LIGHT (有危害的光線)**

Black light – effectiveness 黑燈- 使用



黑燈光源不強, 需近距離檢查, 檢查時要去除所有光源

Black light – time 黑燈-時間



3 to 4 minutes

黑燈暖機(眼睛適應黑暗環境)需3-4分鐘

Black light – alternates 黑燈- 類似照明

4W

距離300-500 mm

Desktop lamp used in laboratory 實驗室使用的檯燈

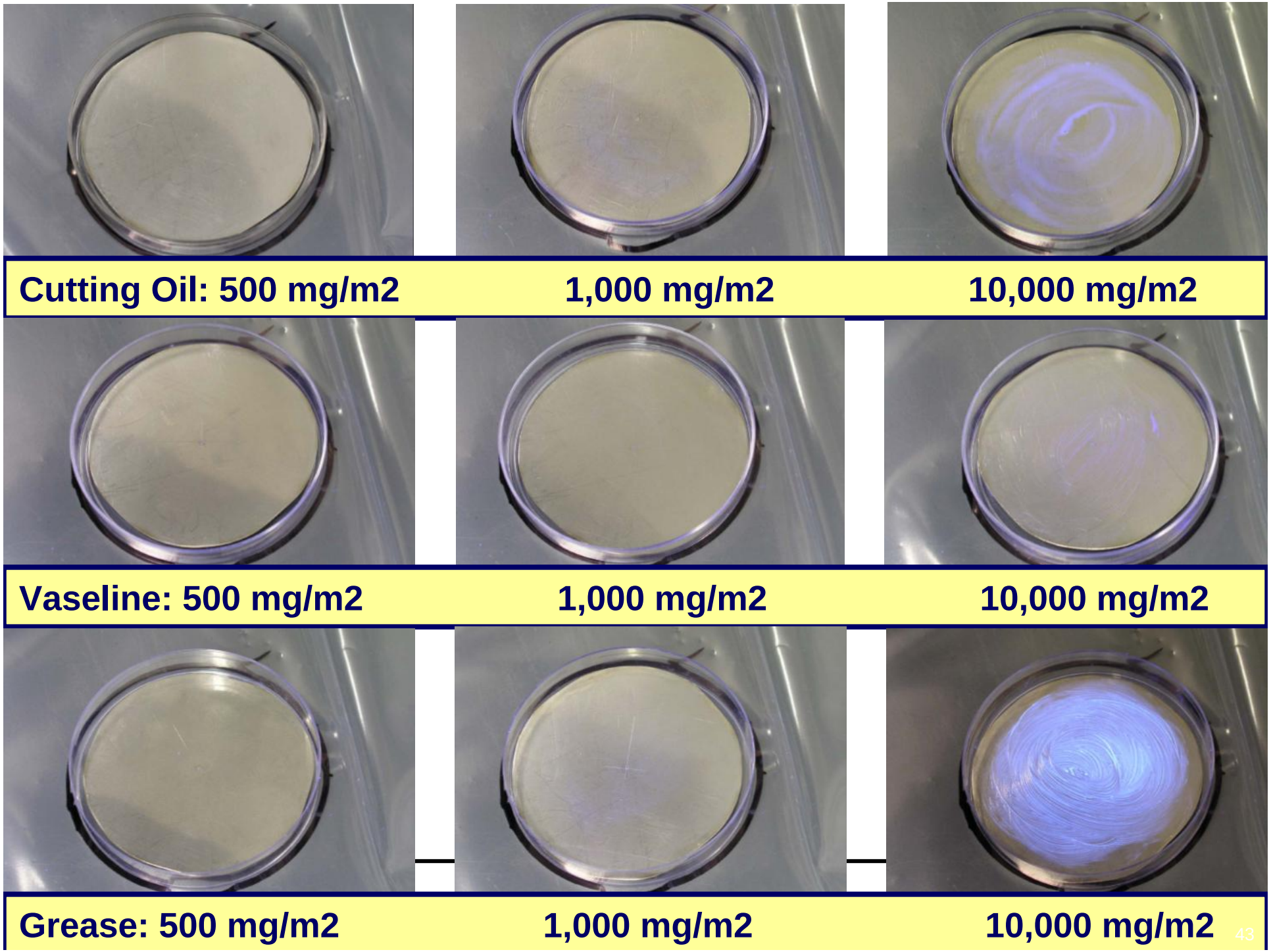
1W

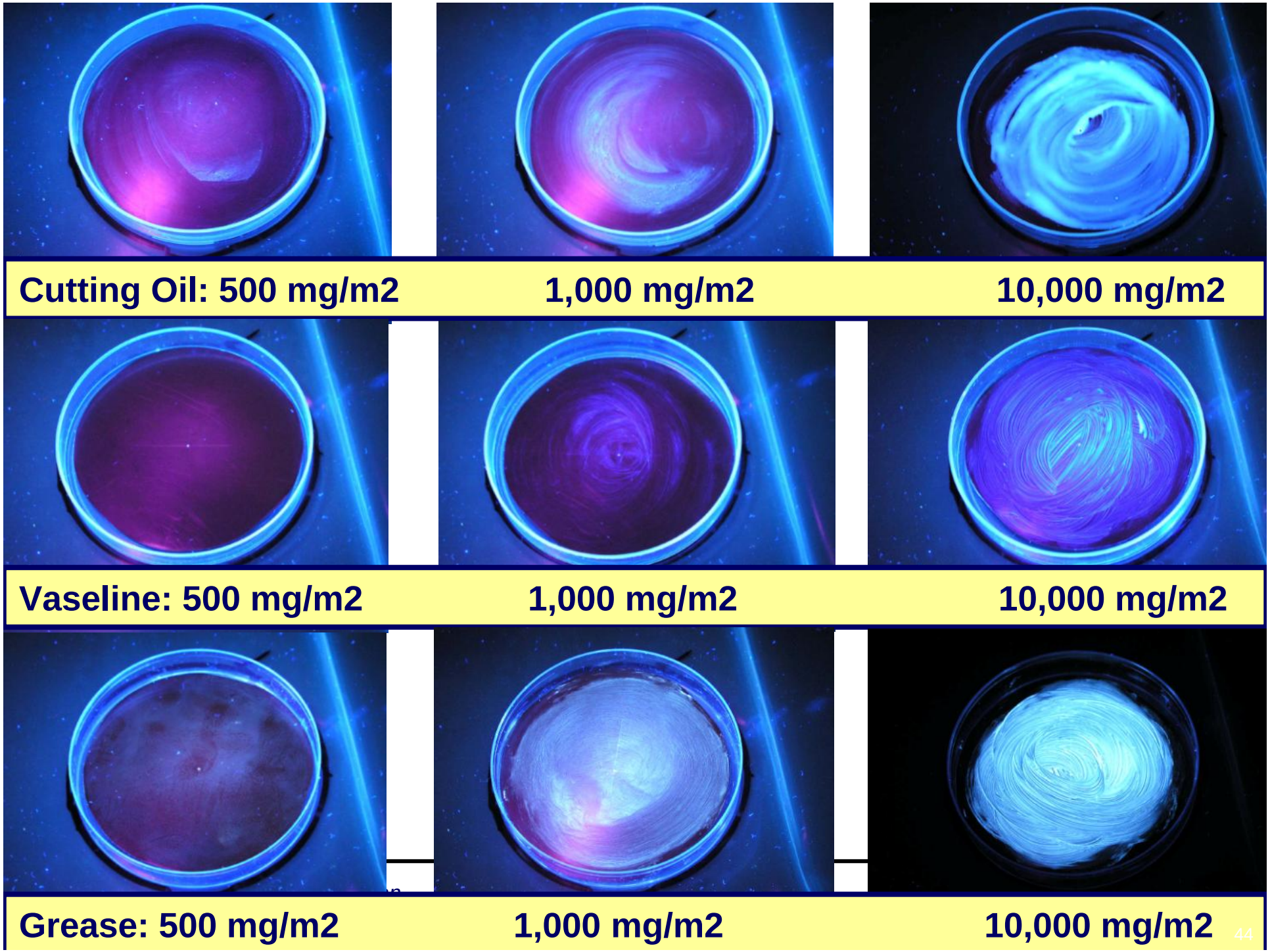
辨識偽鈔, 貼近看

What is the detection capability
偵測能力

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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Grease: 500 mg/m2
1,000 mg/m2
10,000 mg/m2

How much oil is acceptable
可接受的油脂

200mg/m^2 for >30bar

500mg/m^2 for <30bar

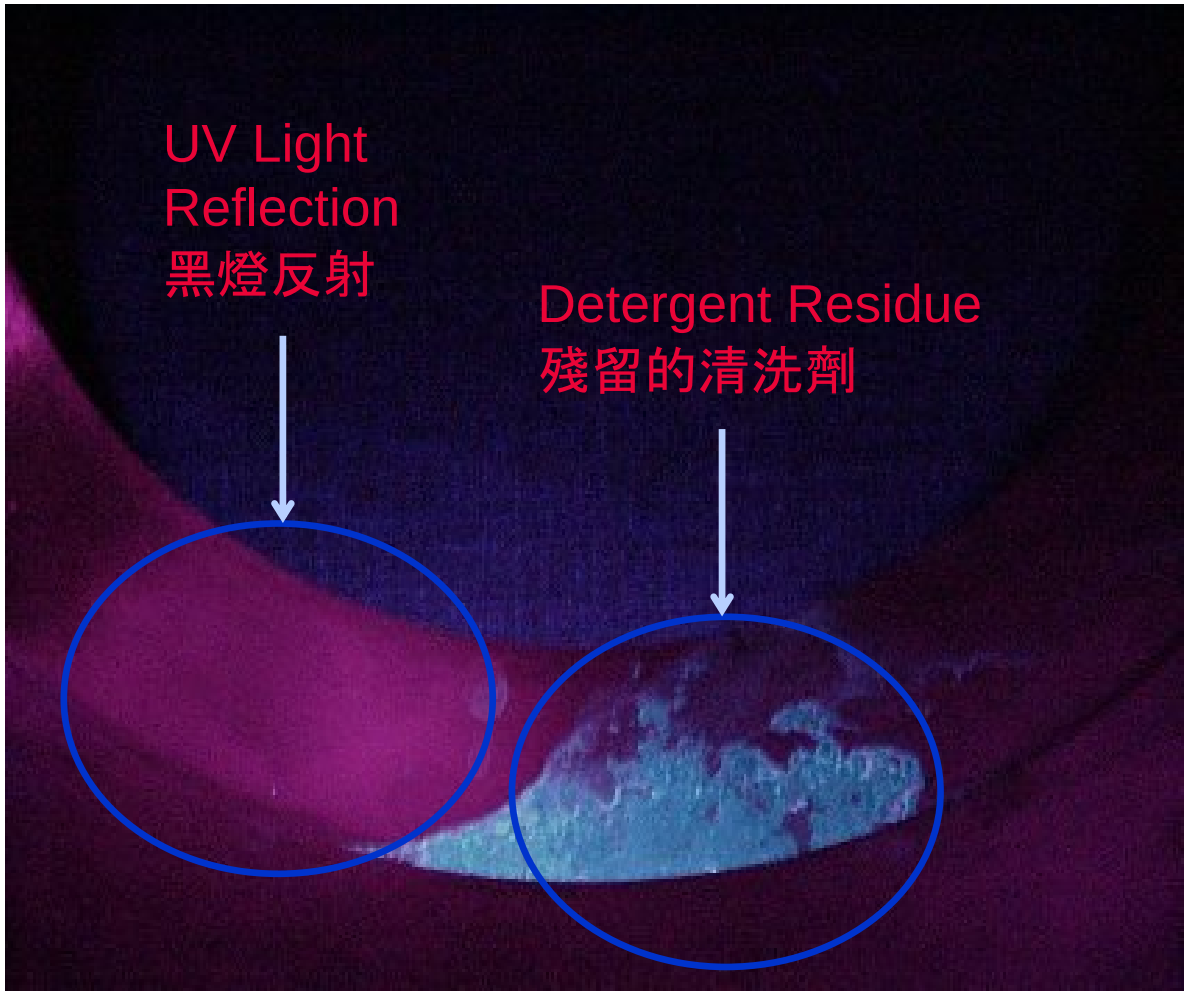
Practical acceptable inspection criteria
實務上可接受的規則

White and Black Light Inspection shall indicate:白燈及黑燈的檢查應該顯示:

- No moisture-----沒有水氣
- No cleaning agents-----沒有清潔溶劑
- No particulate---- 沒有微粒狀物
- No paint, crayon, etc.-----沒有油漆,炭筆殘留等
- No hydrocarbon or organic oils, greases, adhesives, etc.----沒有碳氫或有機油脂,油脂,附著物等
- No excessive accumulations of even approved substances -----沒有超出被核准物質的殘留累積量

NOTHING shall be seen -----應該看不到任何東西

NOT 1 THING 一樣都不應該看到

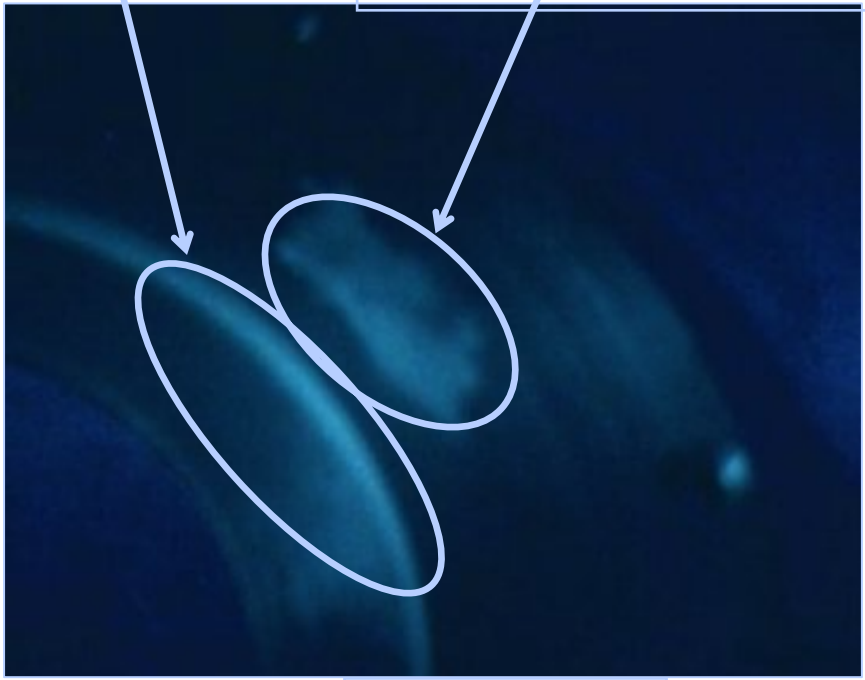

UV Light
Reflection
黑燈反射
Detergent Residue
殘留的清洗劑

Fluorescence of Oxidizer Compatible Grease
氧氣相容的油脂

White Light 白燈

Reflection
反射

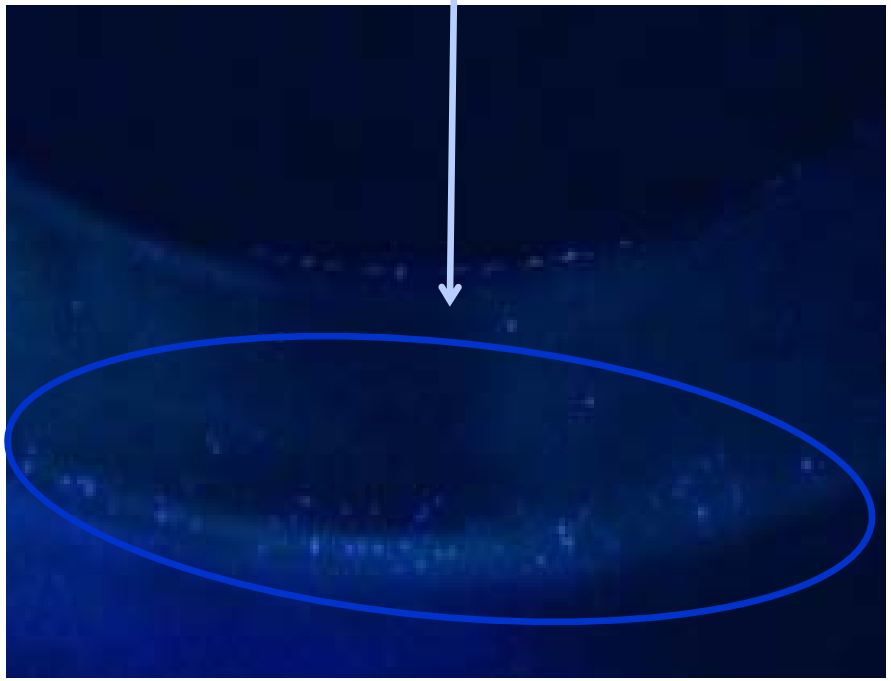
Fluorescence of Oxidizer Compatible Grease氧氣相容的油脂



UV Light黑燈

Threads, Particulates & Lint

捻線, 微粒子, 線頭

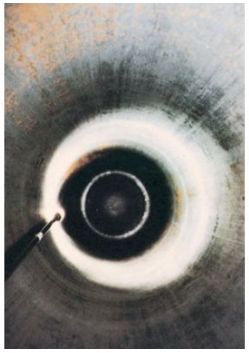


Rust 鐵鏽

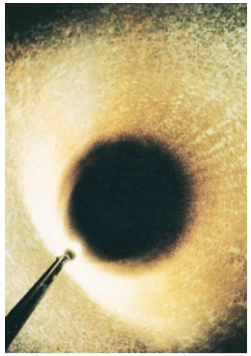
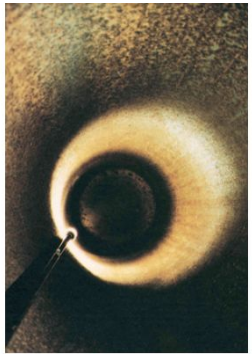
Acceptable Rust
可接受的鐵鏽

Not Acceptable Rust
不可接受的鐵鏽

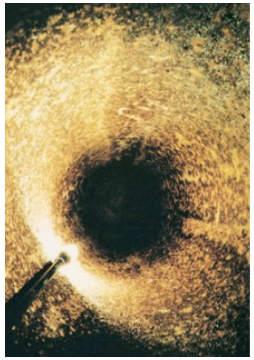
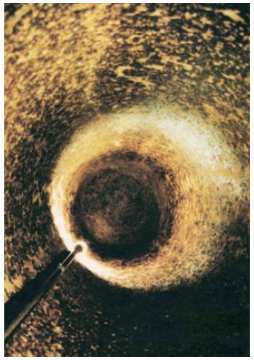
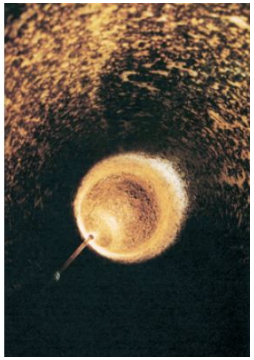
Rust and cylinders 鐵鏽和鋼瓶


As new
如同新品

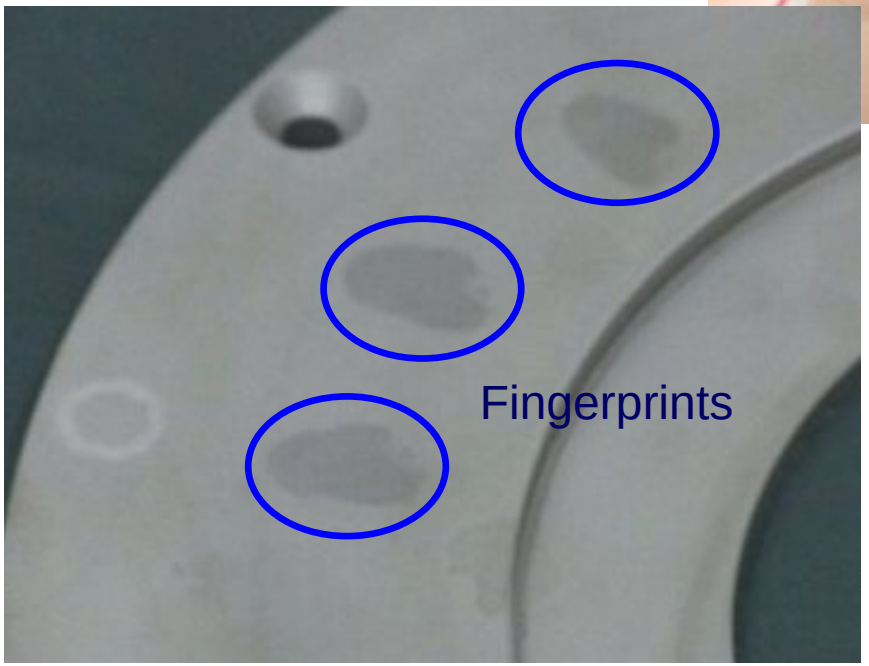




Light pitting which
is acceptable
輕微的小坑洞是可以接受的

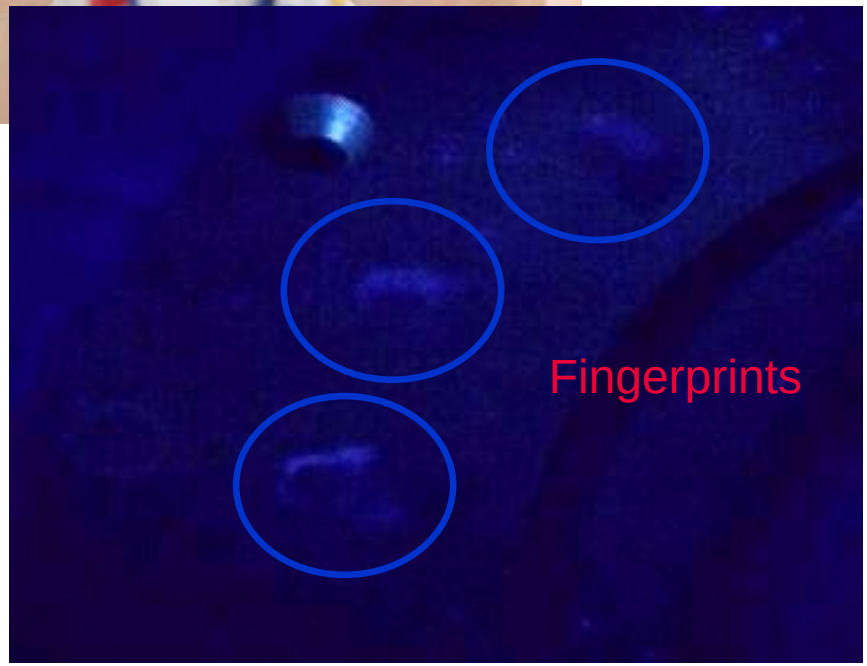




Heavy pitting that would
require shotblasting before
further visual inspection
如果有嚴重的的小坑洞, 則
須在目視檢查前座噴砂處理

Fingerprints
指紋



White Light 白燈



UV Light 黑燈

Post cleaning protection
貼上清潔標示保護

Conclusion 結論

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

  汙染通常是著火的根本原因且是引火鍊的根本來源
- The amount of hydrocarbon required to start a fire is remarkably small 引火所需的碳氫量是非常小的
- Cleaning stuff in the field is harder to do than buying it clean 現場做清潔是比買來就是乾淨的困難很多
- Inspection of cleanliness is limited, and due to the limitation the rule must be “see anything and you have to clean again” 清潔度的檢查是受限制的,由於此限制, 規則必須是”當你看到任何東西, 你就必須再清潔一次”.

Thank you

謝謝

Original Presentation by
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at EIGA 2012 Meeting

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