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Fire Resistant Hydraulic Fluids

Improving Safety, Reducing Risk

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- Fire Resistant Hydraulic Fluid Overview
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Hydraulics

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Overview

- Hydraulic systems are used for the generation, control, and transmission of power by the use of pressurized fluids.
- In the early 1900s, mineral oil based fluids became the most used hydraulic fluids due to inherent lubrication and fluid mechanical properties.
- While mineral oils are inexpensive and have good technical properties, they are extremely flammable.

Minimize Risk

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Mineral Oil Fires Can Lead to

- Safety risks for staff
- Capital loss of millions
- Production losses

» Fire-resistant hydraulic fluids should be used in such applications to control risk

Fire-Resistant Markets

ALUMINUM

» Smelting

» Casting

» Cold and Hot Rolling

POWER GENERATION

» Turbines

TUNNELING

» Tunnel Bore Machines (TBM)

OFFSHORE

» Blow Out Preventer (BOP)

MINING

» Longwall Roof Supports

» Storage Fluid

» Mobile equipment

TUBE & PIPE

» Casting

» Hot Rolling

STEEL

» Casting

» Cold and Hot Rolling

» Galvanizing

DIE CASTING

» Casting

» Heat Treating

Fire resistant hydraulic fluids are used in applications:

- **Located in high temperature environments**
- **Close to open flames to reduce fire risks and consequential losses**

Fire Resistant Hydraulic Fluids

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Water-based Fluids

HFA-E Oil in water emulsions
water content > 80 %
common use 1 to 5 % HFA-E

HFA-S Synthetic aqueous solutions
water content > 90 %
common use 1 to 5 % HFA-S

HFB Water in oil emulsions
water content ~ 40 %
oil content ~60%

HFC Water glycol solutions
water content > 35 %

Water-free Fluids

HFD-R Phosphate ester based

HFD-U Based on other compounds, mainly synthetic polyol ester and natural esters (renewable resources)

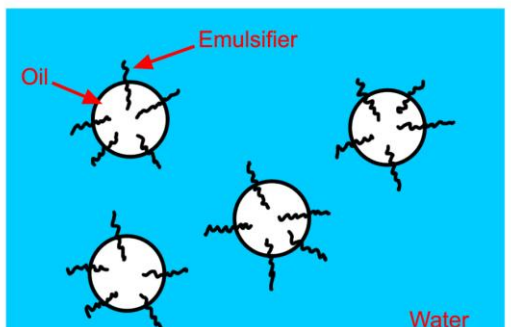
→ QUINTOLUBRIC® 888

Properties HFA-Emulsions

Oil-In-Water Emulsions

- High water based fluids which generally contain 95% H_2O and 5% mineral oil
- Offer excellent fire resistance due to high water content
- Stable, non-toxic, economical and readily available
- Typical operating temperatures is between 41◦F - 131◦F
- Water and oil content monitored with use of refractometer
- Are used where high fluid losses can be tolerated

- Use is limited to light duty systems
- Lower long-term corrosion preventatives, lubrication and viscosity than mineral oils
- Bacterial attack due to high water content requires pH control (>8) and biocide use



Properties HFB-Invert emulsions

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Water-In-Oil Emulsions

- Called invert emulsion or “mouse milk”
- Typical formulation is 40% water and 60% oil
- Fluid loses fire resistance below 35% water and anti-wear protection when water content exceeds 45%
- System operating temperatures is between 41◦F - 140◦F
- Very stable in hydraulic systems

- Foaming can be an issue
- Reduction in viscosity at high shear rates
- High specific gravity holds contamination particles more readily than mineral oils

Properties HFC- Water Glycol

Water Glycol

- Solutions of water, ethylene glycol, and additives with high viscosity poly glycols
- Typical formulation contains 35-45% water
- Perform at low temperatures better than water-in-oil emulsions
- Typical operating temperatures is between -4°F - 140°F
- Product will become thicker when water evaporates
- Very good fire resistance due to high water content
- Low in cost, similar to mineral oils
- Represents 50% of the fire resistant hydraulic fluid market

- Low performance attributes leading to lower component service life and requiring increase fluid management

Properties HFD- Synthetic Fire Resistant Fluids

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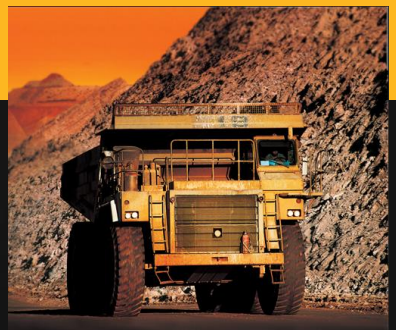
Synthetic Fire Resistant Fluids

- Predominantly either polyol esters or phosphate esters
- Fluid performance equivalent to mineral oil based products
- Used in high temperature environments including
  - Steam turbine governors
  - Steel mills
  - Aerospace
  - Mobile equipment
- Excellent fire resistance - Self extinguish and do not propagate flame
- Very good lubricity characteristics
- Excellent anti-wear properties, shear stability, and oxidation stability



HFD-Phosphate Esters vs Polyol Esters

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HFD-R (Phosphate Esters)

ADVANTAGES

- Highest fire resistance
- Good initial lubrication but can age/oxidize quickly

DISADVANTAGES

- Expensive (10-15 times cost of mineral oil)
- Combustion fumes are neurotoxic
- Materials to formulate are CMR (carcinogenic, mutagenic, reprotoxic)

HFD-U (Polyol Esters)

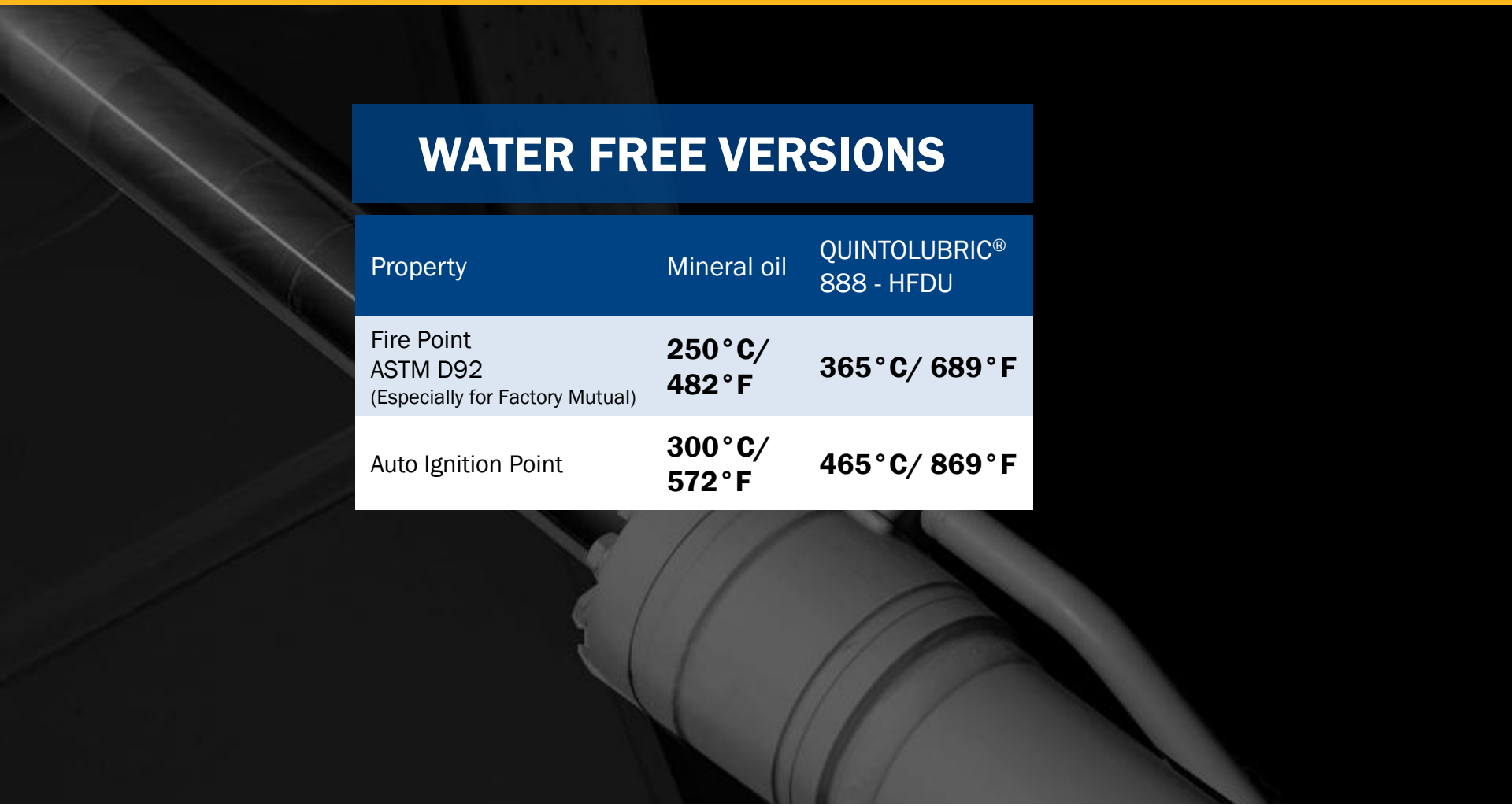
ADVANTAGES

- High fire resistance
- Relatively inexpensive (2 times cost of mineral oil)
- High life of oil with good lubrication properties
- MSHA approved and can replace certain fire suppressant systems
- Biodegradable/non-toxic

DISADVANTAGES

- Higher cost than mineral oil

Fire Resistance



WATER FREE VERSIONS

Property	Mineral oil	QUINTOLUBRIC® 888 - HFDU
Fire Point ASTM D92 (Especially for Factory Mutual)	**250°C/ 482°F**	**365°C/ 689°F**
Auto Ignition Point	**300°C/ 572°F**	**465°C/ 869°F**

Fire Resistance

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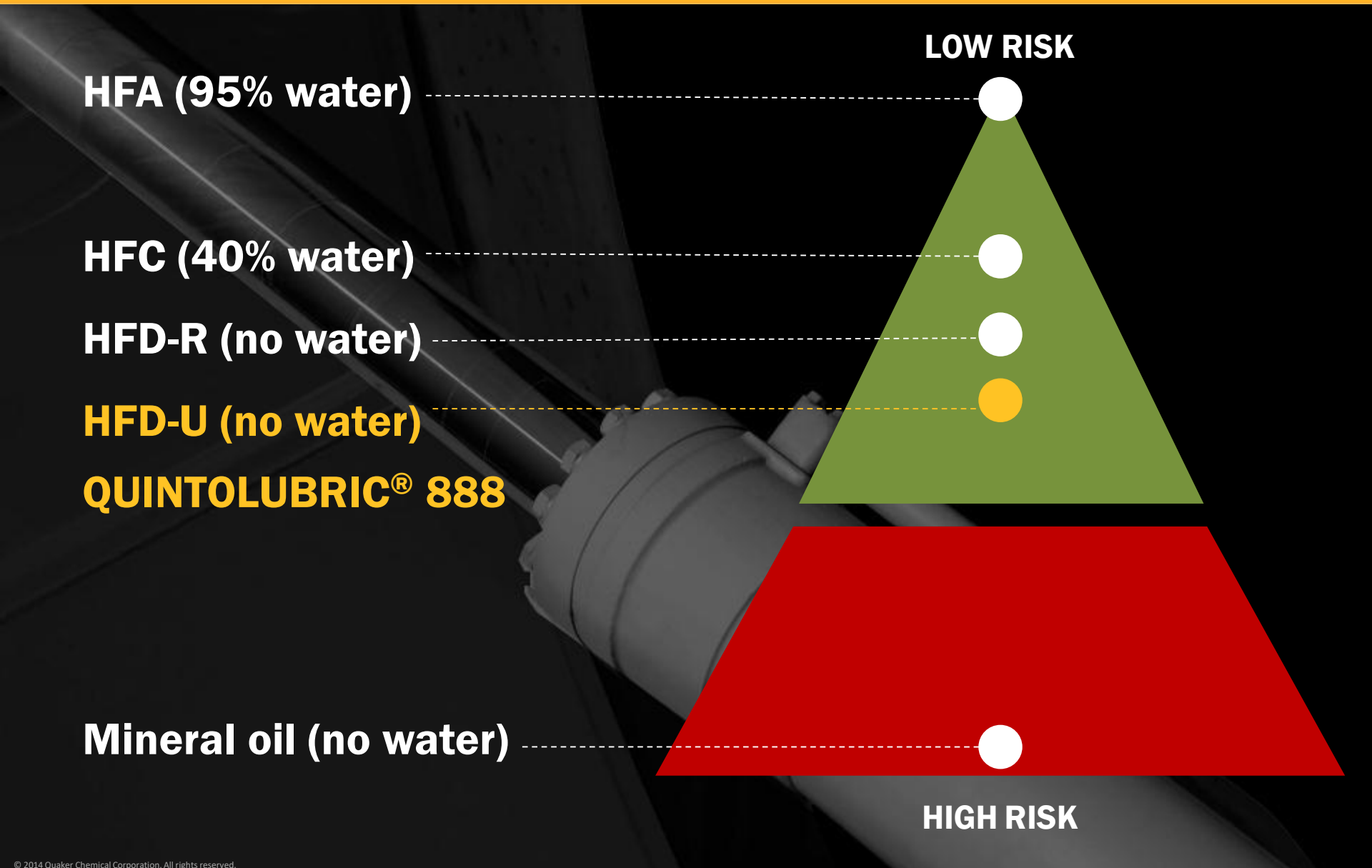
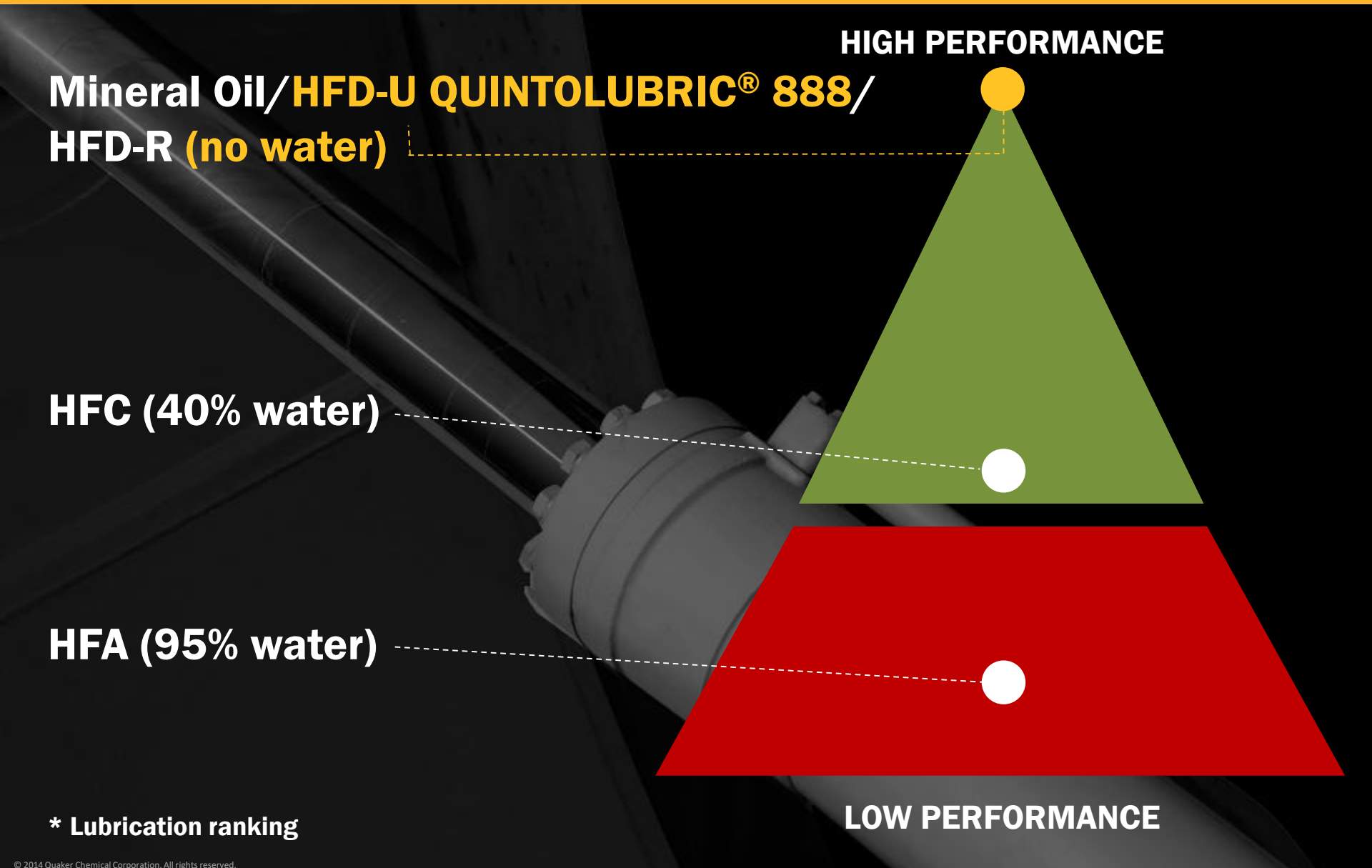
Fire Resistance - Safety

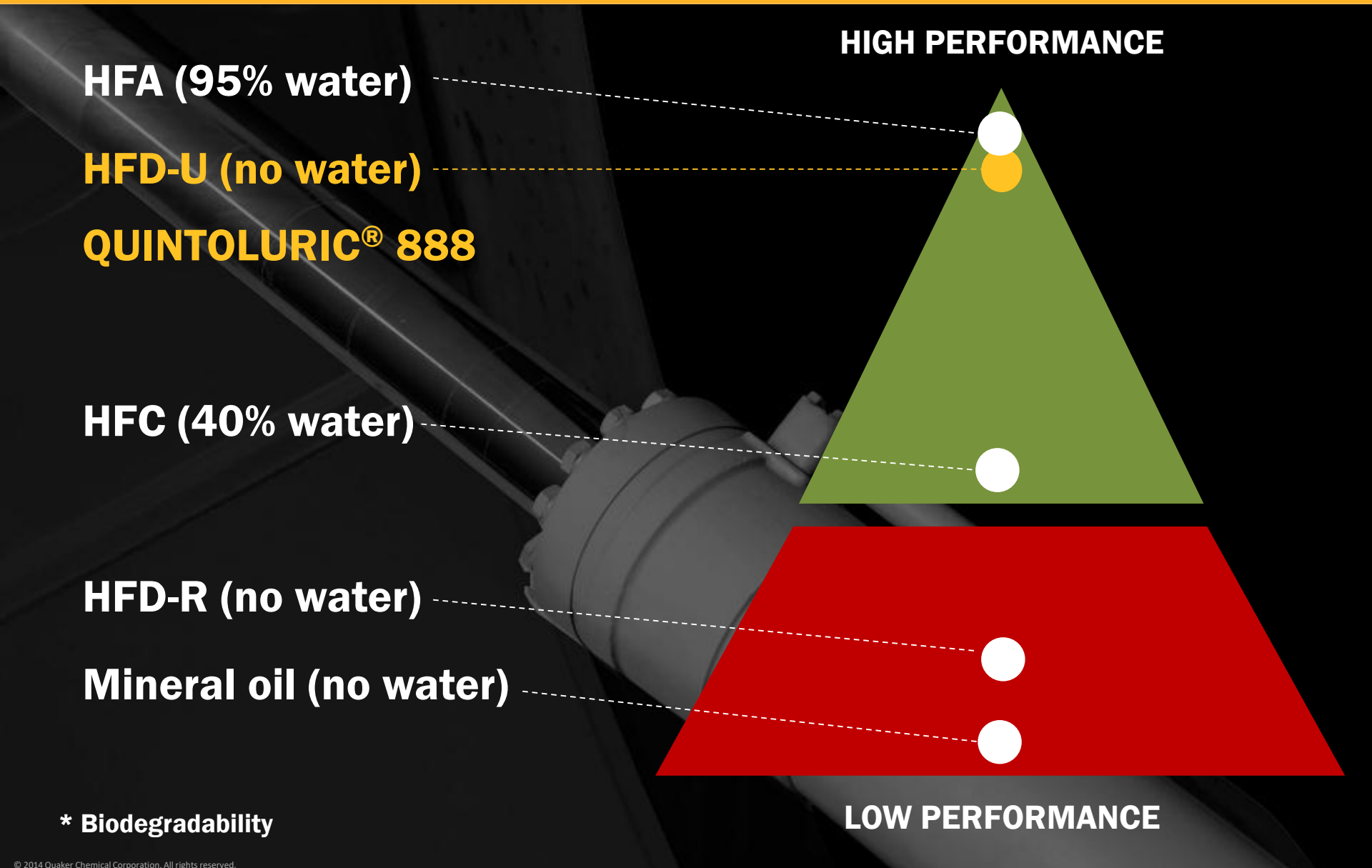


Hydraulic Performance



* Lubrication ranking

Environmental Performance



* Biodegradability

HFD-U: The Best Solution

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Fire Resistance – Safety

NO RISK

Hydraulic Performances

HIGH PERFORMANCE

Environmental Performances

HIGH PERFORMANCE

● **HFD-U (QUINTOLUBRIC® 888)**

Hydraulic Fluids Overview

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The best solution

Property	Mineral oil	Phosphate ester (HFDR)	Emulsions (HFA)	Water Glycol (HFC)	PAG (HFDU)	QUINTOLUBRIC® 888 (HFDU)
Fire resistance	- -	+ +	+ + +	+ + +	+ and -	+
Environmental performance	-	+ and -	+ +	+ and -	+ and -	+ +
Thermal stability	+ +	+ +	- -	-	+ and -	+
Maintenance	+	- -	- -	- -	+	+
Component life	+	+ and -	- -	- -	+	+
Price	+ +	- -	+ + +	+ +	-	+ and -
Total Cost of Operation	+ +	-	- - -	- -	+ and -	+

- - is relatively bad
++ is relatively good

Fire Resistance

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SUMMARY

- While mineral oil is inexpensive, it can create safety and environmental issues
- Fire resistant hydraulic fluids and greases increase operational safety without sacrificing performance

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Thank You