



Shell Global Solutions

## Choosing the right hydraulic fluid

**1 in 7 litres of hydraulic fluid  
sold world-wide is branded Tellus**



# Choosing the right hydraulic fluid

This presentation aims to highlight some of the key areas of hydraulic fluid design and selection, highlighting why Shell hydraulic fluids are **the right hydraulic fluid**



# Choosing the right hydraulic fluid

## Baseoil

- Industrial hydraulic oil performance is highly dependent upon base oil composition.
- Baseoils need well-defined and consistent performance in the areas of air release, water separability, foaming and oxidation resistance.
- These fundamental properties cannot be provided simultaneously by additives.
- It is relatively rare for a hydraulic oil to be rejected because of excessive oxidation unless prolonged exposure to sustained high temperatures has occurred or the oil has been over-used.
- The symptoms of excessive oxidation are thickening, an increase in weak organic acidity and a darkening in colour.
- Shell's 50 year experience in manufacturing, testing and formulating with baseoils for hydraulic fluids ensures consistently high standards, which have made Shell Tellus the World's leading brand.

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## Additives

- Additive components may be particularly sensitive to contamination by water so assessment of wet filterability is important.
- Problems with additive interactions may also occur if different brands of hydraulic oil are mixed in one system.
- Shell's fluids within a range are compatible and interchangeable, for example the Shell Tellus range of mineral based fluids.
- Shell spends significant effort in developing and testing the right additives to maintain compatibility and leading performance.

# Choosing the right hydraulic fluid

## Zinc or Zinc-free?

- The lubrication requirements of modern systems can only be satisfied by enhancing performance with additive treatment. Zinc-based anti-wear systems continue to be common although sulfur-phosphorus alternatives are increasingly used where higher load carrying capabilities are required.
- Low load low temperature regimes, where some anti-wear additives may not be sufficiently active to protect surfaces, should also be considered in choosing the fluid.
- Shell Tellus Oils S Zinc-free hydraulic oils for severe duty are 'top-tier', anti-wear hydraulic oils formulated to be the ultimate 'high reference oil' in the hydraulics industry.
- Based on advanced 'zinc and chlorine free' technology, Shell Tellus Oils S are formulated to ensure exceptional performance in hydraulic fluid power transmission systems subjected to severe duty.

# Choosing the right hydraulic fluid

## Thermal Stability

- Thermal stability is important when system capacity is relatively small, residence time in the reservoir is short and elevated temperatures up to 90°C are experienced for significant operating periods.
- Degradation products can initiate corrosion and generate deposits. In turn the desposits can block filters and degrade system cleanliness.
- Shell tests it's range of hydraulic fluids against the internationally accepted standards for Thermal Stability. Thermal Stability being a recognised feature of Shell Tellus S, and Tellus. Tellus is generally acknowledged to be the 'standard-setter' in the field of industrial hydraulic and fluid power lubrication.

# Choosing the right hydraulic fluid

## Metal Compatibility

- Modern hydraulic systems contain a wide range of construction materials and the formulation must offer comprehensive multi-metal capability. Steel and copper protection are a pre-requisite.
- Shell has developed a range of in-house tests in addition to the international standards to ensure our products are compatible with hydraulic system components and the environment they work in.
- The work during development is further tested by field trials.
- Tellus S, Tellus, Tellus T and Tellus TX offer corrosion protection as a performance feature.

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## Biodegradability

- Biodegradable hydraulic fluids are becoming of increasing interest primarily for mobile applications where the impact of contamination by accidental spillage or leakage of the hydraulic fluid on sensitive environments is required to be as low as practicable.
- Commercially available hydraulic fluids are most commonly based on natural or synthetic esters the latter offering improvements in service life and reduced sensitivity to degradation in the presence of water.
- Ester-based products are generally compatible with most construction materials found in systems designed for use with mineral oils although certain plastics, elastomeric seals and industrial adhesives may be susceptible to premature attack.
- Shell's range of biodegradable lubricants (Shell Naturelle HF-X, HF-E and HF-M) have been field trialed in mobile forestry applications to ensure their suitability.
- As a company Shell is committed to developing environmentally acceptable hydraulic fluids.

# Choosing the right hydraulic fluid

## Multigrades

- Multigrades find applications when hydraulic fluids are subjected to high rates of shear.
- New specifications and classifications for multi-grade hydraulic fluids in Europe and in the United States are emerging.
  - *Mannesmann Rexroth, Poclain Hydraulics and Denison Shear-stability requirements*
- More severe test methods for multi-grade hydraulic fluids are being used.
  - *sonic shear test*
  - *taper roller bearing test.*
- Shell's recent development of Shear Stable Tellus TX illustrates the expertise highlighted in previous slides:
  - the selection of the correct baseoil
  - the selection of the correct viscosity index improver
  - the selection of additives to give thermal stability
- The result is a shear stable product offering the customer measurably better performance.

# Choosing the right hydraulic fluid

## Fire resistant fluids

- For high risk environments where combustibility of the hydraulic fluid is of primary importance a range of fire-resistant hydraulic fluids is commercially available.
- Each offers a different balance of fire resistance cost-effectiveness service life mechanical performance operating temperature and pressure range and maintenance invention.
- Shell markets a comprehensive range of fire resistant hydraulic fluids, covering the HFA, HFB, HFC and HFD categories. HFA, HFB and HFC fluids contain water.



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## Water based fluids

- Periodic microbiological infestation of systems containing water-based fluids is relatively common and Types HFA and HFB are the most susceptible.
- Post-treatment of systems with biocides may be necessary to control bacterial and fungal infections and in some instances they may prove extremely difficult to eradicate.
- Short fluid life, corrosion and premature filter blockage with biofilms are characteristic end results of chronic microbiological activity and a systematic approach to fluid management is essential under these circumstances to contain maintenance costs and retain system availability and reliability.

# Choosing the right hydraulic fluid

## HFA emulsions

- In the Type HFA category there are three main product groups: conventional emulsifying oils, oil-free synthetic solutions and thickened micro-emulsions.
- The conventional emulsifying oils, branded Tellina, are extended with water to form oil-in-water emulsions at oil phase concentrations of typically 2-5 v/v% find application primarily in powered roof supports in deep mining.
- High resistance and cost-effectiveness are balanced against modest lubrication performance and the necessity for continuous monitoring of fluid condition.
- The fluids are generally unsuitable for use with rotary pumps and spool valves.

# Choosing the right hydraulic fluid

## HFA emulsions

- Advances in technology over the past 15 years has enabled special HFA formulations - micro-emulsions of oil-in-water - to be developed. Irus A demonstrates improved emulsion stability and lubrication performance relative to Tellina.
- Further enhancements have been obtained by the inclusion of polymeric thickeners. Irus AT 10 and AT 37 are suitable for primary metals manufacturing.



# Choosing the right hydraulic fluid

## HFB water based fluids

- With water-based fluids there is a trade-off between fire resistance and lubrication performance. Increasing water content improves fire resistance although lubrication performance tends to deteriorate particularly with respect to rolling element bearing fatigue life.
- Irus BLT fluids, so-called 60-40 invert emulsions, containing about 40% v/v water represent a good compromise for many applications and have been the preferred selection for hydraulic systems on mobile deep mining machinery in the UK.
- The principal drawback of invert emulsions is their susceptibility to organic growth, which can lead to filter blockage and system failure. Irus BLT fluids contain biocides to reduce this susceptibility, but levels need to be maintained, either through top-up or by addition of biocide concentrates.

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## HFC water based fluids

- Iruis C, an HFC water-glycol, in common with all other water-glycol fluids are of inferior bearing fatigue performance relative to invert emulsion fluids.
- Their deficit in lubrication performance compared to invert emulsions can be overcome by correct component selection and moderating system pressure.
- These fluids are the only viable fire-resistant fluid selection when operating temperatures significantly below 0°C.



# Choosing the right hydraulic fluid

## Polyester fluids

- Irus DU, a polyester type, offers more fire resistance than mineral oil and is attractive when no system re-engineering is envisaged.
- These fluids exhibit high flashpoints and lower volatility though their inherent fire resistant properties are inferior to most of the other options available.
- Care should therefore be exercised if selecting these fluids for high risk applications. Care needs to be taken to ensure that suitable fire quenching systems are available.



# Choosing the right hydraulic fluid

## Phosphate ester fluids

- Irus DR, a phosphate ester-based fluid, displays high fire resistance and is the obvious selection where operating temperatures preclude the use of water-based fluids (bulk fluid temperatures above 65°C).
- Additionally these fluids require less service intervention than water-based fluids. Technology is now available to re cycle phosphate ester fluids providing the extent of contamination and degradation is modest.
- Provided the products are handled and used as recommended they do not represent any significant risk to health and safety.