Market Trends in Tractor Hydraulic Fluids

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Chevron ORONITE

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- OEM Trends and Specifications
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- Tractor Evolution and THF Impact

Agricultural Machinery

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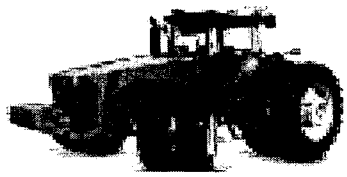
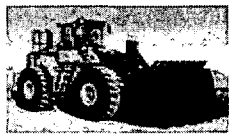
- ***Farm Machinery***
  - Farm Tractor
  - Cultivator
  - Rice planting machines
  - Combine
  - Binder



THF are also used in the construction industry



Global Farm Tractors in Use
1993 through 2002

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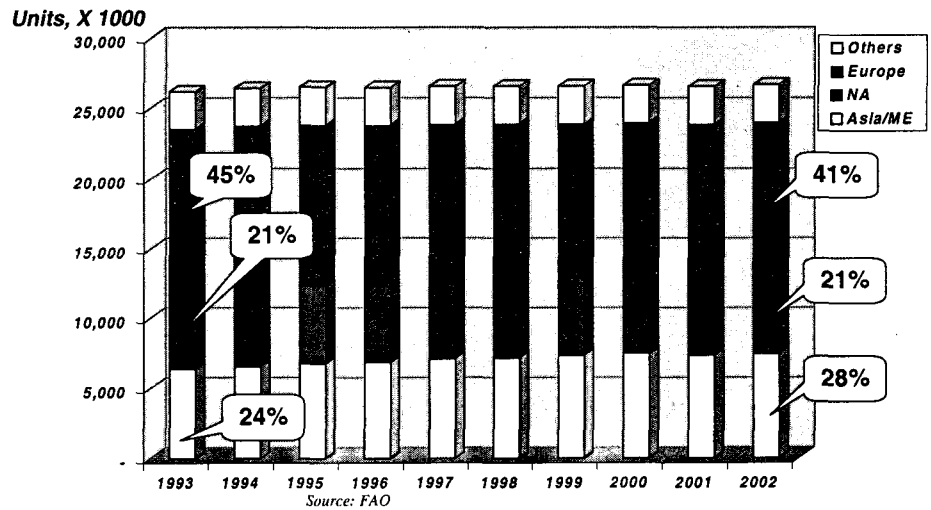
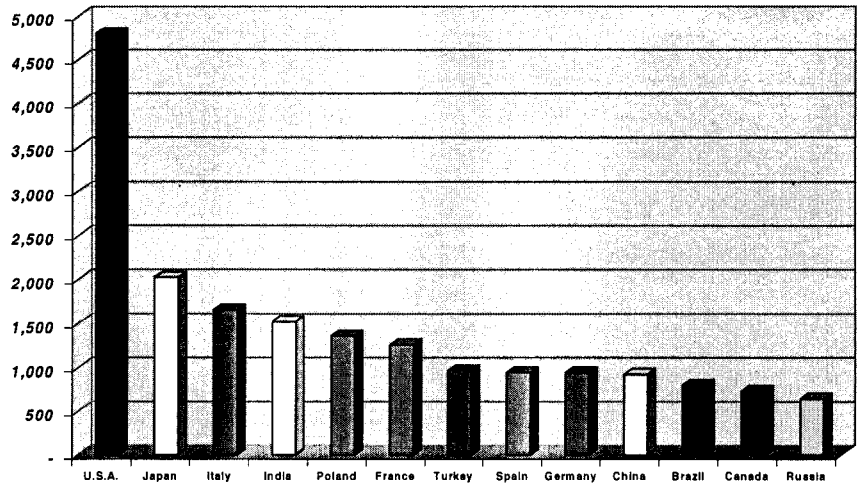


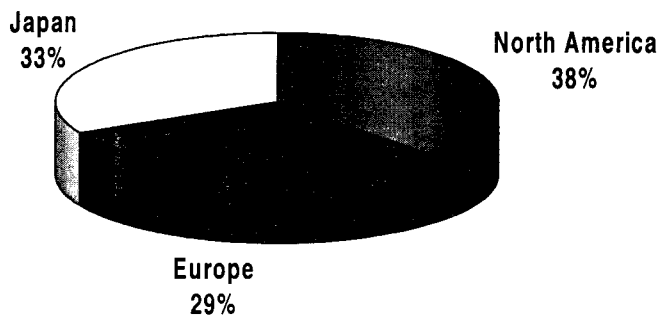
Source: FAO

Farm Tractors in Use
Top 10 by Country in 2002



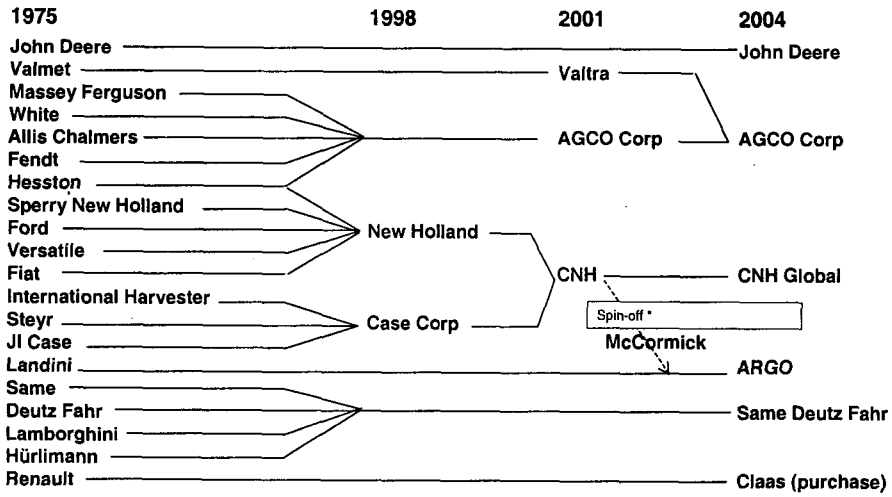
Source: FAO

Farm Tractor Sales in 2002
- NA, Europe & Japan -



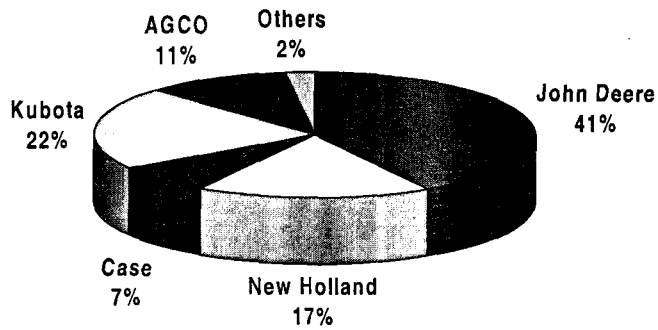
Total 500K Units

Changes in the Farm Equipment Industry in North America and Europe



Note*: mandated by government further CNH merger

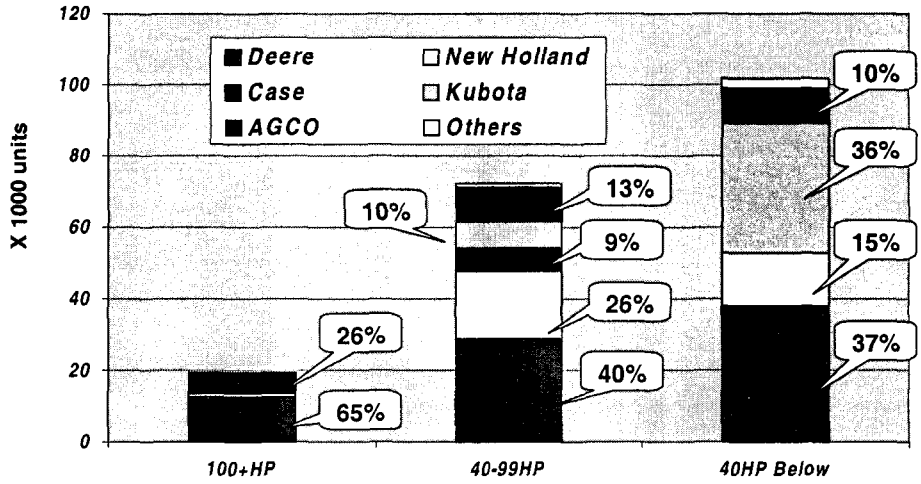
Farm Tractors *North America* Sales 2002 By OEM



193K Units

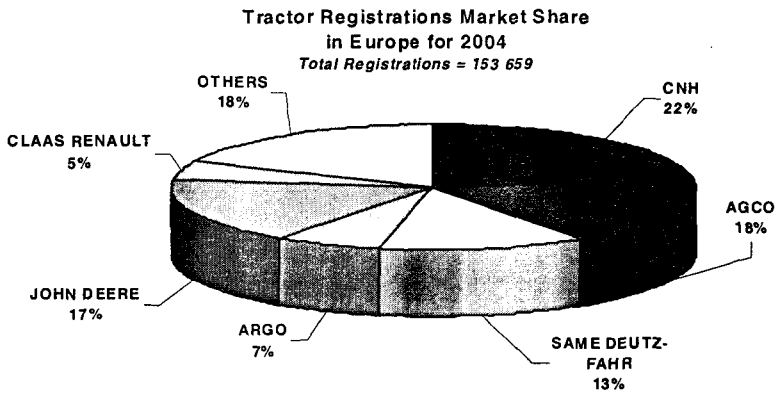
Source: Stark's Research NA Outlooks:2007-2004, Farm Machinery

Farm Tractors *North America*
Sales 2002 By Tractor size/OEM



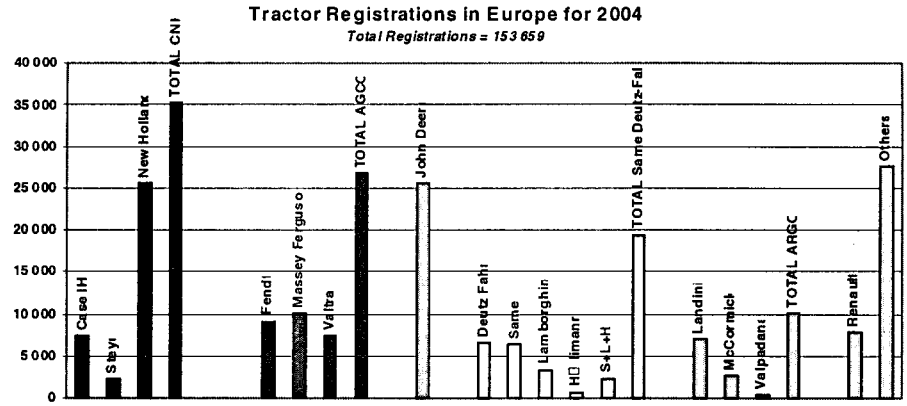
Source: Stark's Research NA Outlooks:2007-2004, Farm Machinery

Farm Tractors *Europe*
2004 Registrations by OEM



Source: Décisions Machinisme May 2005
Countries: Italy, Portugal, Sweden, Austria, Switzerland, Slovenia, Norwa
Spain, Belgium, Germany, France, Finland, Denmark,

Farm Tractors *Europe*
2004 Registrations by OEM Group



Source: Décisions Machinisme May 2005
Countries: Italy, Portugal, Sweden, Austria, Switzerland, Slovenia, Norwa
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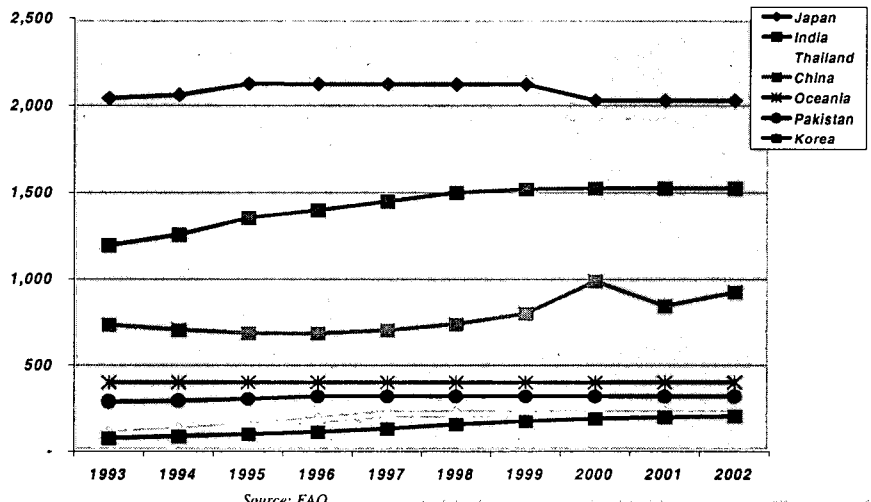
Trend of Farm Tractors in Use
Major Asia Pacific Countries 1993-2002



Source: FAO

Farm Tractors *APR (Ex. Japan)*
Estimated Updated Market size

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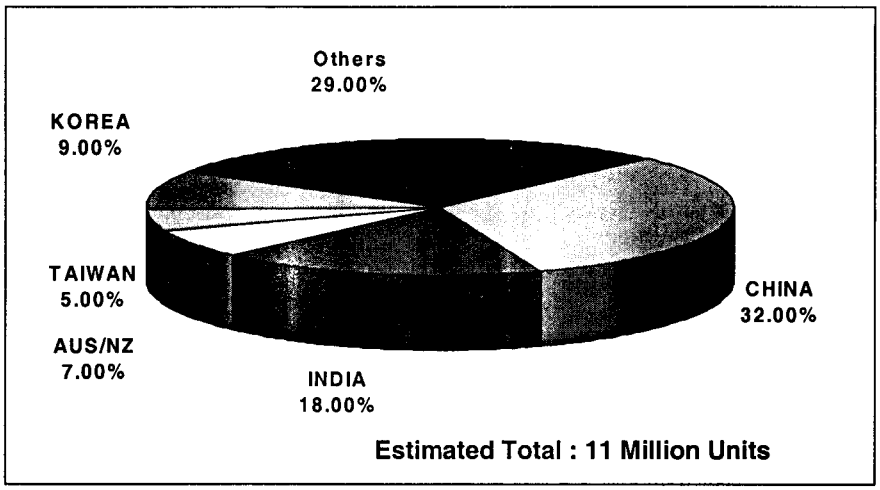

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Farm Tractor Sales in Japan

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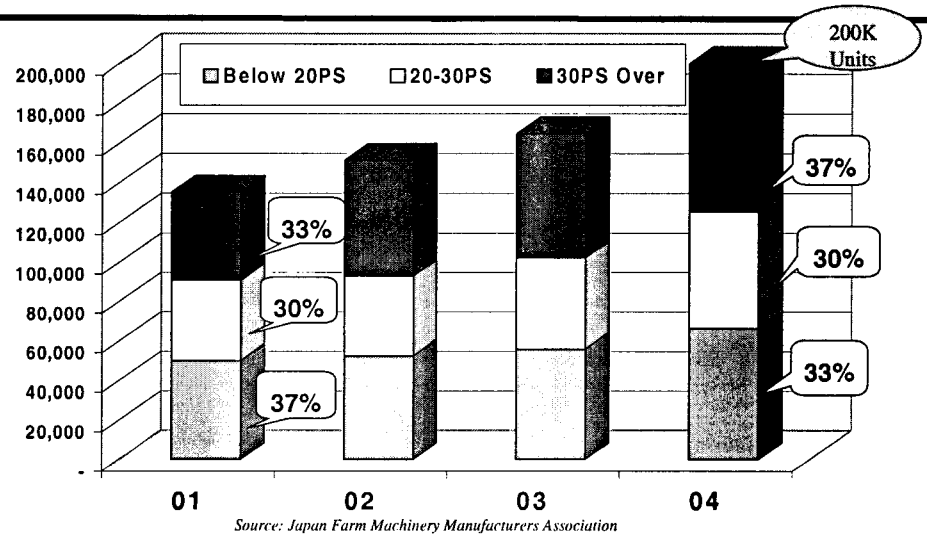

Source: Japan Farm Machinery Manufacturers Association

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Agricultural Machinery in Japan Sales Units vs. Realization in 2004

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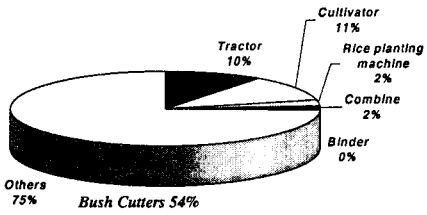
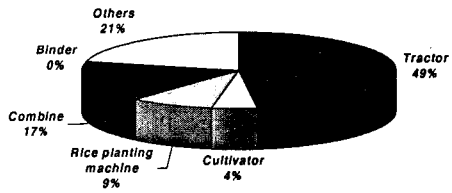


Realization Yen 501Billion

Total Units 1,923K



Source: Japan Farm Machinery Manufacturers Association

Tractor Makers and Specifications

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- Each of major tractor makers has developed one or more specifications for the THF it wants to see used in its equipment
- While most of the tractor makers want roughly similar properties in their fluid, they may specify different limits on different tests to achieve what they want
- Most of the major tractor makers market their own house branded hydraulic fluid formulated to their specifications

Major Specifications & Approval

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	John Deere	Case & New Holland (CNH)	AGCO	ZF
Major Specifications	JDM J20C (Normal temp. range fluid) JDM J20D (Low tem. range fluid)	MAT 3505 (Case MS 1209) MAT 3525 (FNHA-2-C-201) MAT 3526 (FNHA-2-C-200)	CMS M1143 (UTTO) CMS M1135 (UTTO) CMS M1145 (UTTO/STOU)	TE-ML-03E (Converter transmission) TE-ML-05E (Axles) TE-ML-03G (Converter transmission) New Extended drain TE-ML-03G (Axles) New Extended drain
Approval System	"Self Certifying" Self approved based on passing data from standardized testing	New Holland Based on review of data from standardized testing (No letters are issued) Case No fluid approval process	Finished oil approvals	To appear on the ZF approved lubricant list, marketers have to apply to ZF

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Major Tractor Manufacturer Component tests Specifications

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	J20C/D	FNH A-2-C-201	CMS M1135	CMS M1143	CMS M1145	Case MS 1209	Kubota UDT
Brake Noise	JDQ 96	7610 Tractor on the Road	MF Brake	-	-	*Case*	*Kubota Brake*
Brake Capacity	JDQ 96	7610 Tractor on the Road	-	-	-	*Case*	-
Clutch Capacity	JDQ 94 (Paper)	High energy clutch (Paper)	MF IPTO (Sintered)	MF Friction (Paper and sintered)	MF Friction (Paper)	*Case (sintered)*	SAE 2 (Sintered, Paper)
Gear Wear Protection	JDQ 95	Ford 3000 axle	MF 4 Square Rig	FZG FLS 9 min	FZG FLS 10 min	FZG 7 min *Case*	IAE Gear
Pump Performance	JDQ 84 - Piston	Vane pump	-	V104C - Vane	35VQ25A - Vane	*Case*	-
Oxidation Stability	C4 THOT (162깂)	Bench	Bench	Bench	Bench	Bench	Bench

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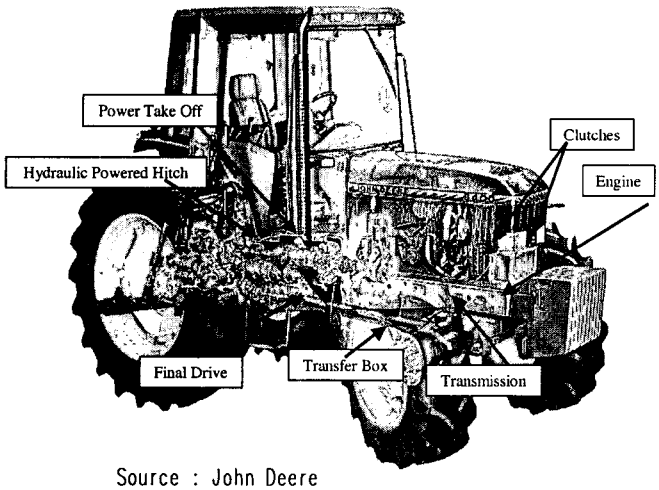
Farm Tractors and Lubricants



Source : John Deere

Lubricating Parts	Lube Oil
Engine	Engine Oil
Powertrain - Transmissions - Final Drives - Wet Clutches	THF Tractor Hydraulic Fluid
Hydraulic Systems	
Wet Brakes	

History of THF

- ***1960*** : "Common sump" design combined transmission and axles and required unique lubrication
- ***1970s*** : First generation THF developed without Sperm whale oil
- ***Early 1980*** : Second generation THF developed to improve gear wear protection and brake chatter control. In Japan, next generation THF for brake chatter performance with water contaminated fluids
- ***Middle 1980s*** : Further improvements of THF offered higher gear wear protection and oxidation control. Japanese OEMs started to develop next generation THF
- ***Early 1990s*** : Movement towards reduced fluid viscosities required equivalent wear protection, oxidation control and friction characteristics, more power shift transmissions in use
- ***2000s*** : In US, fluids made with wider temperature limits, better low temp fluidity, Group II and Group III base oil blends

Global THF Market Trends

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- Consolidation of Agriculture OEMs continue
- Low hp (below 40hp) tractors continue to grow
- Global THF market size is estimated to be 620KMT
- Few lubricant marketers, except OEMs, differentiate THF on performance
  - Deere & Case aggressively promote their genuine oils

Asia Pacific THF Trends

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- Asia Pacific market is growing and market size is estimated :
  - Farm Tractors Population : 13 millions
  - THF lubricant size : Approx. 50 KMT
  - China, India, Japan, Australia/NZ, Korea, Taiwan, Thailand are major countries
- Agriculture has started to become more mechanized
  - All American, European & Japanese OEMs & their JVs have active presence in this market
- Leading OEMs in specific countries typically drive THF specs
- Special THF required for Japanese Tractors
  - Require Quiet brakes with water contaminated fluid

THF (Tractor Hydraulic Fluid)

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- THF (Tractor Hydraulic Fluid) or UTTO (Universal Tractor Transmission Oil) or are designed to lubricate:
  - Powertrain, including Power take-off
  - Wet brakes
  - Hydraulic systems
- THF do not lubricate the engine
- THF are formulated:
  - To match OEM specifications
  - To perform well in all tractors and agricultural equipment plus most tractor OEM construction equipment
    - Hardware evolution impacts THF performance requirements

Important Properties of Today's THF

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- Transmission & Wet Brake Oil –Friction characteristics
  - Clutch capacity
  - Brake capacity & chatter
- Gear Oil – Gear Wear Protection
  - Wear
  - Pitting/ Spalling
- Hydraulic Oil – Piston and Vane pump wear protection
  - Wear
  - Pump Efficiency
- Fluid Properties
  - Oxidation stability
  - Thermal stability
  - Water tolerance
  - Corrosion protection
  - Rust inhibition
  - Filterability
  - Antifoaming
  - Elastomer compatibility
  - Shear stability

Equipment Trends - Modern Tractors

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- Modern tractors :
  - Use one or more hydraulic pumps / motors to power implements, accessories and in some cases as the vehicle drive source (Hydrostatic transmission).
  - Utilize different gear designs as appropriate
  - Use clutch packs to transfer power... multiple friction materials are used
  - Use wet brakes to stop the tractor... various friction materials are used

Equipment Trends - Today and Future

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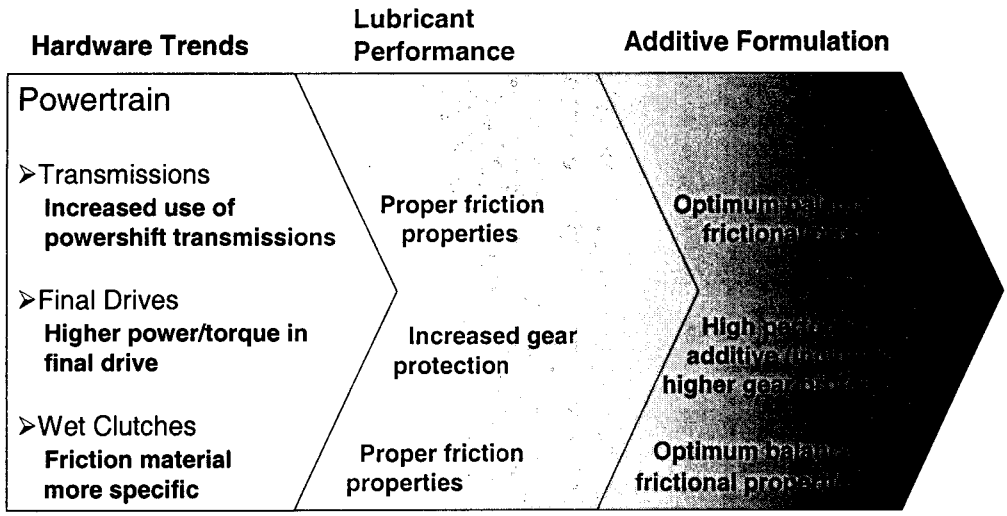
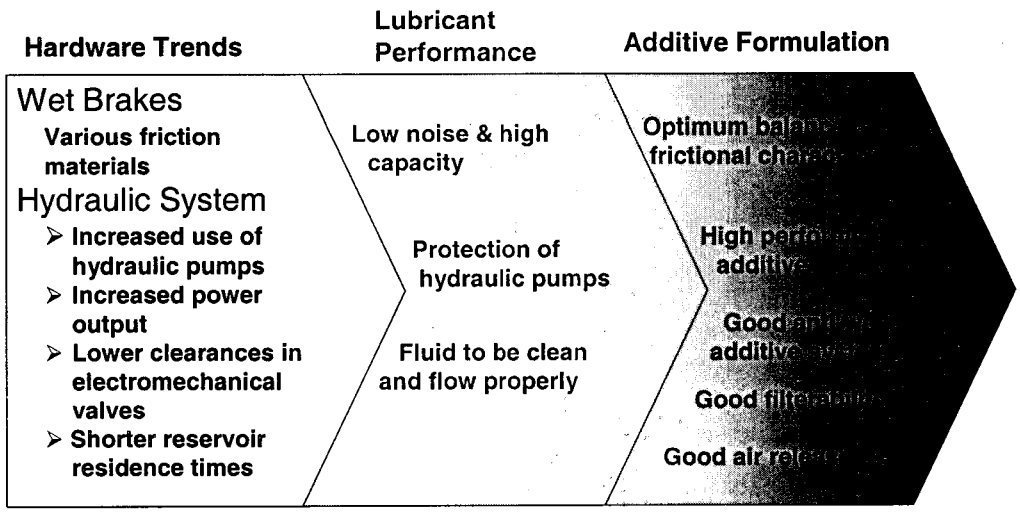
- Increased use of electronic controls
  - Electro-mechanical valving
  - Small tolerances, tighter valve clearance
  - Fluid must be kept clean
- Increased use of powershift and hydrostatic CVT/IVT transmissions
  - Complete / partial powershift transmissions increasing in usage
- Higher power/higher torque in axles and final drives
- Sumps are getting smaller
- Increased use of hydraulic systems

Tractor Hardware Evolution and Impact on THF (1)



Tractor Hardware Evolution and Impact on THF (2)



Tractor Hardware Evolution and Impact on THF (3)

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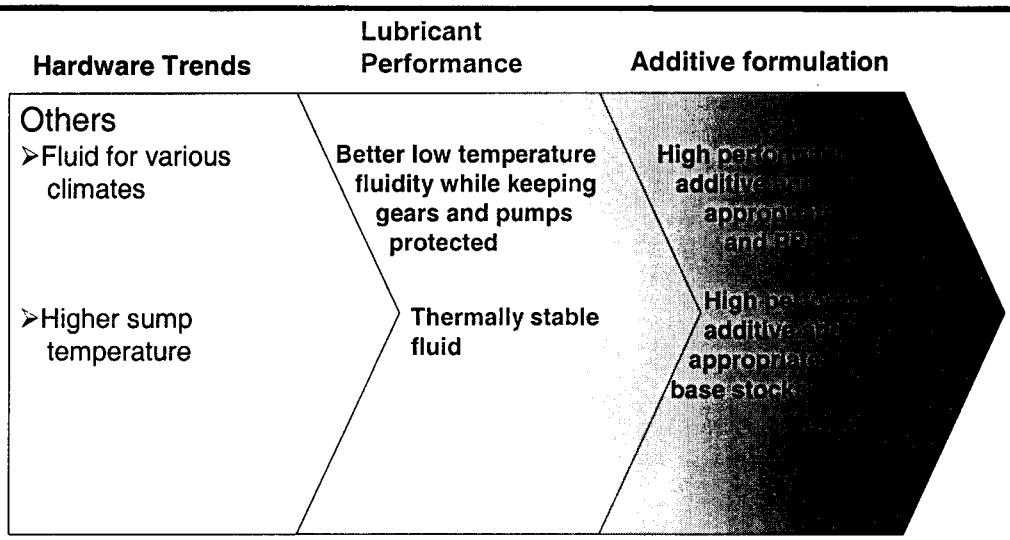

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Summary

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- Farm equipment market very cyclic – weather, economic factors, import/export markets
- Mergers of companies continuing
- Major Tractor OEMs have lubricant specifications
  - Their own house branded THF
  - Constant review reflecting the changes in equipment
  - Less interest in approving outside additives/oils for others
- Future THF lubricant market
  - "Universal" THF may give way to individual products for each OEM
  - Sumps are getting smaller
  - Increased use of hydraulic systems *vs.* mechanical
- Additive companies will need to meet many challenges

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