



John Deere Hybrid Technology 油電混合理論

Customer Solutions

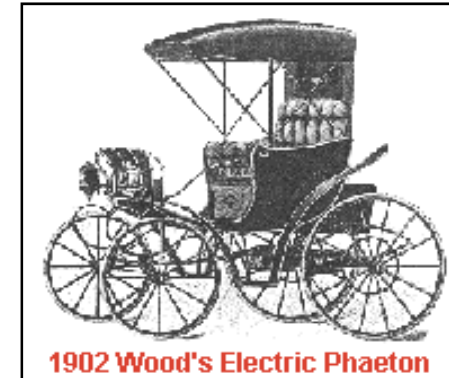


JOHN DEERE GOLF

Hybrid Technology - History & Timelines

油電混合-歷史

- First electric vehicle was invented between 1832 - 1939. 第一台電動車於1832-1939年間發展.
- 1899 to 1900 high point of electric cars. They outsold all other types. 1899 到1900是電動車全盛時期. 銷售量也比其他車種要高出許多.
- 1902 Wood's Electric Phaeton 1902年 伍茲電動4輪車
- Electric vehicles had many advantages: 電動車的優勢
 - Less Vibration, Pollution, Noise & No gear Changes. 少一點震動少一點汙染及噪音 & 無齒輪更換
- Why they die? 為什麼沒有成功?
- 1916 Woods Hybrid Car, Internal Combustion Engine & an Electric Motor. 1916年伍茲油電混合車是內然引擎及電動馬達
- What happened when unleaded gasoline/petrol was introduced? 在無鉛燃油問世後發生甚麼事情?



Hybrid Technology - History & Timelines

油電混合-歷史

- 1994 Ransomes E-Plex, world's first electric Triplex GM. Noise & pollution free mowing.
1994年第一台無噪音無污染Ransomes E-plex 電動3連滾刀割草機
- What happened to it? 發生甚麼事?
- 2000 June Golf Course Management mag. Ransomes E-Plex II can cut 18 to 22 greens on a single charge, driven by conditions.
Did it? 2000 6月高爾夫雜誌: Ransomes E-plex II 每一次充電後可以割18到22個果嶺.這是事實?
- 2007 Feb E-PLEX II. 2007年2月 E-plexII
 - They now believe they have it right. 他們相信他們做對了
 - 13 years later! 13年後!!

Toro - Where are they? Toro-這個市場的定位?



Hybrid Technology - History & Timelines

油電混合-歷史

2005 - John Deere introduced the 2500E Hybrid Riding Greens Mower

2005年 John Deere 發表2500E 油電混合果嶺割草機

- Gas & Diesel – HD 48V System, Electric Reel Drive – Cutting Edge Technology 汽油及柴油- HD48V的系統, 電動滾刀馬達-最先進的技術
- Hydraulic Reel Drive System eliminated – reduces hydraulic leaks (102 points) 液壓式的滾刀馬達系統完全消失-大約可以減少102個可能漏油的點
- Quieter Operation from Electric Reel Drive System. 電動滾刀馬達提供更安靜的操作選擇
- Feedback on the 2500E has been very positive.所有的測試報告都是正面的
- Reduced fuel consumption (up to 30%+) being reported. 可以減少燃油的使用 (達30%).



Hybrid Major Components

油電混和割草機中重要的部件

Alternator: 發電機

- Powers Reel Circuit 供應滾刀馬達電力



Brushless Motor:

無碳刷式電動馬達

- 1 For each reel 每一個滾刀一個

Controller: 控制器

- 1 Controller per reel 一個控制器控制一個電動滾刀馬達
- Controls power to the reel and does diagnostics for each circuit 控制及穩定單一獨立滾刀迴路



Reel Control

Switch Box: 滾刀控制組

- Controls 控制
 - Reel Speed 滾刀速度
 - Forward / Reverse 正轉/逆轉
 - Mow & Backlap Switch 割草及倒磨開關

Hybrid Major Components – John Deere Technology

重要部件中-JOHN DEERE 科技

Reel Motor 滾刀馬達

Several patents on brushless motor technology 於無碳刷式馬達設計中含有幾項專利設計

Poly chain belt drive 設計有齒皮帶傳動

Motor internals epoxy filled for sealing 馬達內循環設計密閉包覆

GORE-TEX® vent added to prevent moisture in motor 另外加入 GORE-TEX® 的防水透氣孔



Controller 控制器

Several patents on controller system 控制器中多項專利設計

Controller maintains proper reel speed 控制器控制穩定滾刀速度

Developed & made by John Deere 這是JOHN DEERE為此特別設計研發的

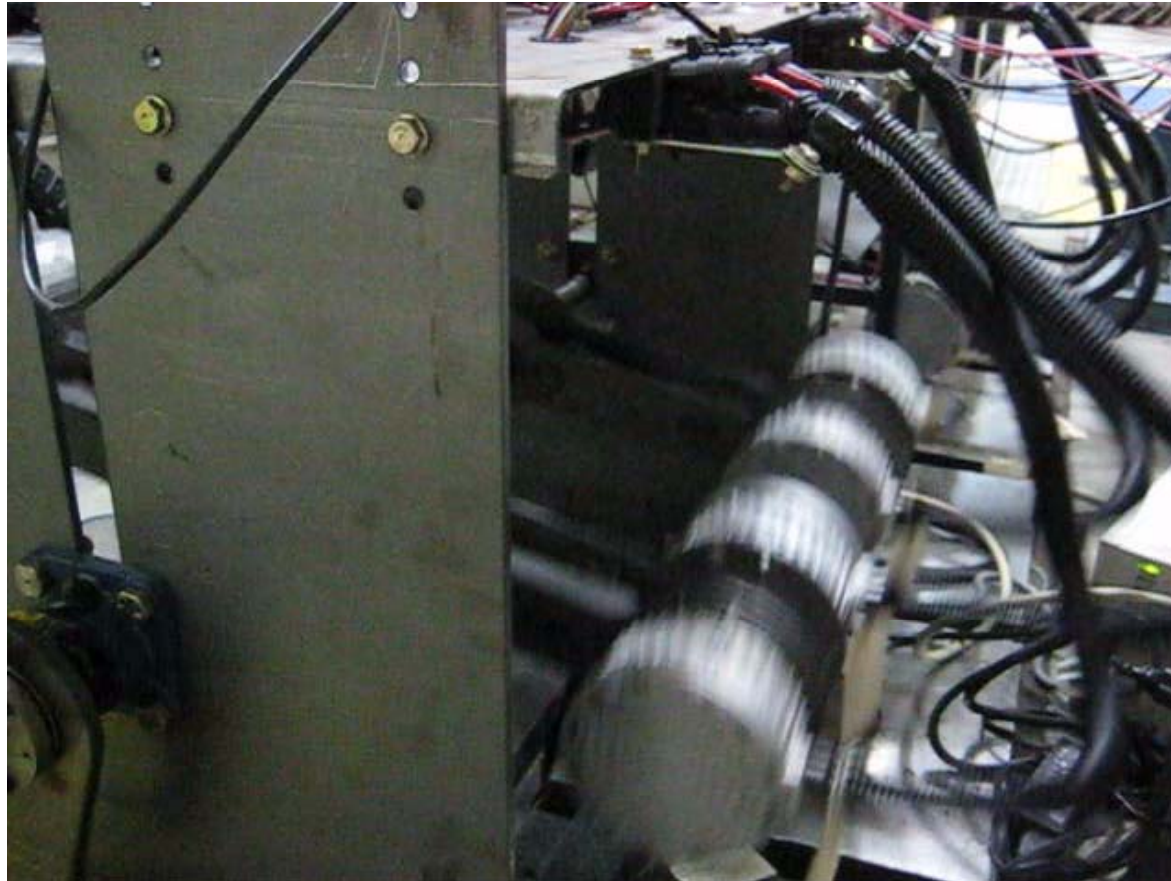
Controller internals epoxy filled for sealing 控制器是密閉設計的



Hybrid Major Component - Motor Test Washing 重要部件 - 防水測試



Hybrid Major Component - Motor Testing and Cable Flex 重要部件 - 馬達振動測試及電線拉扯測試



Hybrid Features & Benefits 油電混合 的優勢及特色

FEATURE 特色	BENEFIT 優勢
Fewer potential leak points 減少漏油產生的點	Reduces chance of a hydraulic leak 減少漏油機會
48v. 90 amp. Alternator-2500E 2500E 果嶺機 48V 90安培 發電機設計 48v. 180 amp. Alternator-all others 其他是運用 48V 180安 培發電機設計	Unit not limited by battery power for run time 機台不會 因為充電問題降低使用效率
Switch box instead of Backlap Valve 控制合與倒磨結合	Can Verticut in reverse without switching hoses. Reduces complexity 可在需要時逆轉滾刀如垂直切割
Reel motor wire harness 滾刀馬達線路設計	Easier to route than hydraulics 比液壓油路設計更容易
Sealed brushless reel motors 密封式無碳刷電動滾刀馬達	Reduces wear/maintenance, runs cooler 減少維修上的部 件
Onboard diagnostic fault codes 車上故障排除偵測碼	Easier diagnostics & repair 比較容易維護及保養
Engine run at 2250rpm 引擎轉速使用在2250rpm (full throttle when verticutting) 但是在垂直切割時需使用全 油門	Less noise, fuel savings up to 30%+ 減少噪音 及節省30% 以上的燃油

Hybrid Features & Benefits 油電混合的特色及優勢

Fewer Leak Points 減少漏油點

Feature 特色

- Eliminated **102** potential oil leak points (Triplex) **150** (LWFM) 減少102個漏油點 (3連) 150個漏油點(球道)
- **90%** of potential oil leaks occur in the Reel Circuit 90%的可能性漏油點來自滾刀馬達迴路
 - 1 - 2 less hydraulic pump/s (reel pump/s) 1-2液壓幫浦 (滾刀幫浦)
 - Removal of backlap valve, reel motors, reel hoses, & oil cooler 減少倒磨閥, 液壓式滾刀馬達, 液壓管及液壓冷卻水箱

Benefit 優勢

- Reduces the chance of oil leaks



Hybrid Features & Benefits 油電混合的特色與優勢

48V – 90/180 AMP Alternator 48V-90/180安培發電機

Feature 特色

- Supplies power to reel controllers & reel motors only 供應滾刀控制器及滾刀馬達的電力
- Replaces the hydraulic pump 替代液壓幫浦
- Testing life exceeds 3000 hours 已經測試超過3000小時

Benefit 優勢

- Unit is not limited by battery power for run time 並不會因為電力供應的問題限制工作小時
- Gives constant power vs. limited power on all electric battery machines (i.e. E-Plex II) 與全電動車比較可以持續供應所需的電力
- Can do unlimited number of greens/fairways with no recharging 所以不會限制工作的小時數不論在球道或果嶺上的工作



Hybrid Features & Benefits 油電混合的特色與優勢

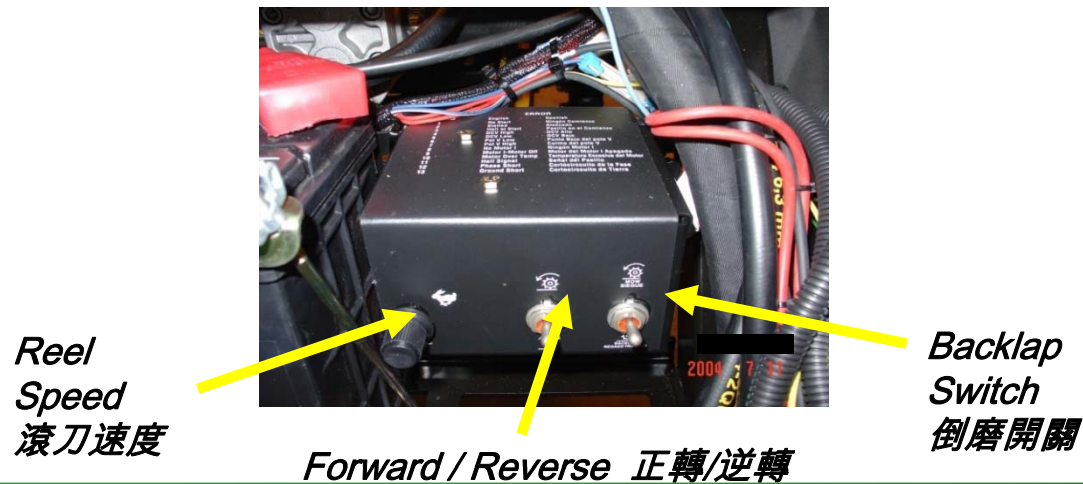
Switch vs. Backlap Valve 開關 VS 倒磨閥

Feature 特色

- 3 Controls: 3組控制器
 - *Speed control*: controls speed of reels in forward and in Backlap 速度控制: 控制滾刀速度正轉及逆轉
 - *Forward and Reverse*: controls direction of reels 正轉及逆轉: 控制滾刀方向
 - *Mow Backlap*: replaces original Backlap switch 割草及倒磨: 替代倒磨開關

Benefit 優勢

- Unit can be used to Verticut without switching hoses (forward/reverse switch) 割草機可以使用逆轉垂直切割刀組 (正/逆轉開關)
- Allows reels to operate off the seat (Backlap switch) 可以直接利用開關使用倒轉



Hybrid Features & Benefits 油電混合特色及優勢

Brushless Reel Motors 無碳刷式電動滾刀馬達

Feature 特色

- **NEW** Brushless reel motors 新的無碳刷式電動馬達
- Testing life exceeded 3000 hours 超過3000小時的測試

Benefit 優勢

- Reduces wear and maintenance on motors 減少滾刀馬達的消磨
- Uses the same cutting units in various models. 所有的機種都使用相同的電動滾刀馬達



Hybrid Features & Benefits 油電混合特色及優勢

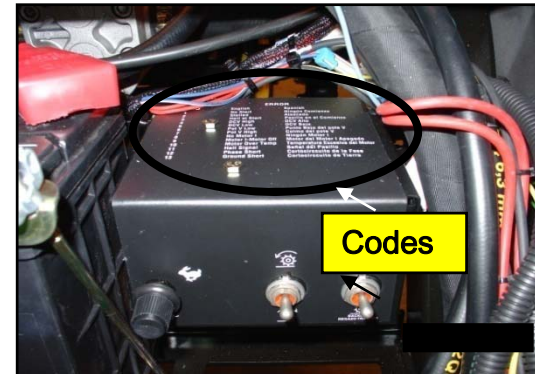
Diagnostic Light 安全偵測碼

Feature 特色

- Diagnostic light for cutting unit circuit 滾刀迴路偵測
- Separate SOS diagnostics for Reel Circuit 獨立的安全偵測碼
- Reel motor controllers have 13 codes for possible electrical failures 13個滾刀迴路偵測碼

Benefit 優勢

- Makes it easier to repair and maintain the electrical system 使用及保養上變得非常便利



Hybrid Features & Benefits 油電混合特色及優勢

Feature 特色

- Because the controller keeps constant reel speed, the 2500E can be run at 2250 rpm under normal greens mowing conditions (including GTC's and power brushes) 因為控制器控制滾刀轉速, 在一般的果嶺剪草條件下, 2500E可以將引擎轉速控制在2250rpm. (包括使用梳草刀組及毛刷)
 - Engine should be run at full throttle when verticutting or when operating under heavy load conditions 在垂直切根的條件下或是特別需要大扭力的長草區時應該使用全油門.

2250 RPM



Benefit 優勢

- Less noise, fuel savings 降低噪音及油耗

2500E Hybrid - Why 2250 RPM? 2500E 油電混合-爲什麼2250 RPM?

- Engine power output still satisfies majority of conditions 引擎在這個轉速下仍可以達到絕大多數的工作需求
- Maintains minimum operating RPM for alternator 這是發電機需要的最小引擎轉速
- Torque curve is still rising 扭力輸出可以穩定向上



2500E Hybrid – Why 2250 RPM? 2500E 油電混合-爲什麼2250 RPM?

Fuel Consumption Monitoring 燃油消耗監測

- Prototype & test units operating at Legacy Golf Course 在Legacy 高爾夫球場測試的結果
- Fuel pump & hour meter readings documented after shift 燃油及工作小時詳細記錄
- Operator instructed to mow at reduced engine speed 操作手使用半油門
- Fuel consumption rates recorded at full & reduced throttle 比較全油門及辦油門使用時的耗油量

2500E Hybrid – Why 2250 RPM? 2500E 油電混合-爲什麼2250 RPM?

30% Fuel Savings 節省30%燃油

- Fuel efficiency varies depending upon mowing conditions 耗油量會根據割草的條件而改變
- Fuel efficiency varies depending upon course layout 耗油量會根據球場的地形而改變
- In high load conditions, engine speed may need to be increased 在嚴苛的割草條件下也許需要提高引擎轉速

2500E Hybrid – Why 2250 RPM? 2500E 油電混合-爲什麼2250 RPM?

Example Scenario 舉例說明

- 2500E Diesel 2500E 柴油引擎爲例
- Wide Open Throttle (WOT) – 0.6 GPH / 2250 – 0.47 GPH 引擎轉速設在 0.6 GPH /2250- 0.47 GPH
- Price of fuel - \$3.50 per gallon (3.8 liters) 燃油價格若爲美金\$3.5 /加侖
- Based on 5 Years of average use 以五年爲例
- Savings over life of machine - \$1365 換算下來可以省下美金\$1365.



Hybrid Features & Benefits

油電混合特色及優勢

Fuel Consumption (2500E Diesel) 燃油耗損

Full Throttle – 0.6 GPH / 2250 rpm – 0.47 GPH 全油門為每小時0.6加侖 在2250rpm時每小時只消耗0.47加侖

Sound Levels at Operator's Ear 對操作手來說的噪音

<u>Engine at WOT</u> 全轉數的引擎	<u>Gas Eng</u> 汽油	<u>Diesel Eng</u> 柴油
W/GTC & Power Brushes 有梳草刀組及刷子	84 db(A)	85 db(A)
Without GTC & Power Brushes 無梳草刀組及刷子	81 db(A)	83 db(A)
<u>Engine at 2250 RPM</u> 引擎轉速設在2250轉		
W/GTC & Power Brushes 無梳草刀組及刷子	83 db(A)	81 db(A)
Without GTC & Power Brushes 無梳草刀組及刷子	79 db(A)	79 db(A)

E-Cut Hybrid Walk Behind Greens Mower

油電混合手推果嶺割草機



220E-Cut Hybrid Walk Behind Greens Mower

Official Supplier



220 E-Cut Hybrid Walk Behind Greens Mower

220 E-油電混合手推果嶺割草機

- **QA5 22" width of cut QA5 22" 割草組**
- **Fully contouring head for undulating greens 完全浮動式割草刀組在果嶺起伏大的地方完全服貼**
- **Adjustable Frequency of Clip 可以根據需求調整剪草頻率**
- **On Board Backlapping 車上備倒磨裝置**
- **Greens, Tees, Collars and Approaches 可用於果嶺梯台領圈及果嶺前緣的割草**
- **2 – 8 units per 18 holes depending on mowing expectations, more if walk mowing greens/tees/approaches 根據要求可以運用2-8台手推式割草機在18洞的高爾夫球場上。**
- **Height of Cut (HOC) .078"(2MM)- .875" (22.2mm) 割草高度: 2mm-22.2 mm (標準設定下)**



E-Cut Hybrid Riding Greens Mower

油電混合乘坐式三連割草機



2500E Hybrid Riding Greens Mower - Gasoline



2500E Hybrid Riding Greens Mower - Diesel

Official Supplier



E-Cut Hybrid Riding Greens Mower

油電混合三連果嶺割草機

2500E E-Cut Hybrid Gas , 2500E E-Cut Hybrid Diesel 2500E 油電混合三連果嶺割草機 (汽/柴油)

- **3 x 22" 11 bladed reels** 3組 22吋11滾刀割草機
- **62" width of cut** 62"總割草寬幅
- **Electric Drive Reels vs. Hydraulic** 電動滾刀馬達
- **Removed 102 Leak Points** 減少102個漏油點
- **Reduction of dba level** 降低噪音分貝
- **Up to 30 percent fuel savings** 減少30%的油耗
- **No battery pack** 沒有電量不足的問題
- **Height of Cut (HOC) .078"(2MM) - 1.25"**
(32 mm) 割草高度: 2mm-3.2mm



THANK YOU