# REBUILDING THE FORD 4.6L ENGINE

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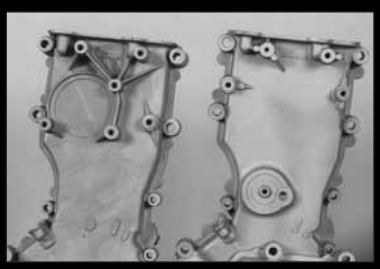
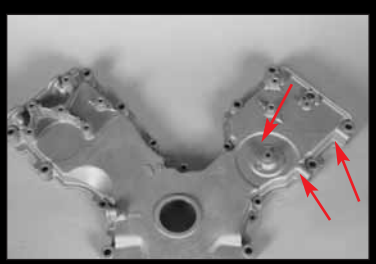
**The 4.6L Ford has been around for over 15 years and it's been used in many of Ford's cars, trucks, vans and sport utilities, so there are well over five million of them out there on the road today. That's good news for rebuilders, because most of them are in vehicles that are worth fixing when they need an engine, but there's some bad news, too.**



*Most of the cars used the F6AE front cover (left) through 1999 and the XR3E/2W7E after that. Note the difference in the bolt pattern and the extra mount for the idler pulley.*



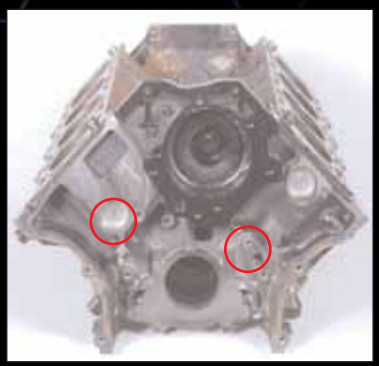
*Ford moved the power steering mount up on the head for most of the trucks in '04 (see charts), so the 3L3E high mount front cover was used instead of the F65E and 1L2E/2L3E-AB truck covers that were used through '03.*

**Ford has made a lot of changes over the years, so building the right engine can be a challenge. In fact, if you include the front cover with the engine, there have been more than 10 short blocks and 20 long blocks used since 1991, so there's plenty of room to make a mistake if you're not paying attention.**

**It's been four years since we sorted our way through all the different versions of these engines that Ford has built, so it's time to take another look to see what has changed since then. There were quite a few different combinations before 1999 and there have been several more since then, but the latest variations all revolve around a few key changes:**

- **The heads are either "power improved" (PI) or "not power improved" (NPI), depending on the engine, the year and the application.**
- **All of these engines came with a heavy crank and rods in 2002.**
- **Some of the Explorers and Expeditions had an aluminum block.**
- **There have been several different front covers used on both the cars and trucks since '99.**

**With all that in mind, let's take a look at what Ford did, year by year, from 1999 through 2004.**



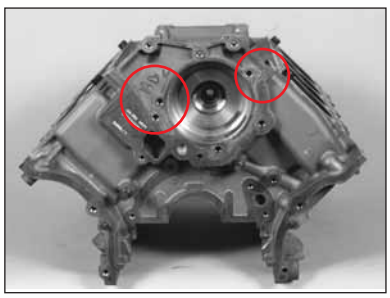
*The dowels for the steel-backed chain guides were deleted on the late XW7E Romeo blocks and a 6.0 mm hole was added on the passenger side because these blocks used the plastic Windsor chain guides starting in '01.*

# Blocks

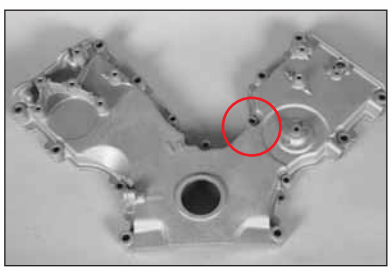
Ford continued to build the 4.6L motors in both the Romeo and Windsor plants through 2004, so there were still two distinctly different blocks in use. Most of the 4.6L engines built during these years were manufactured in the Romeo plant because the Windsor plant was too busy building the 5.4L and 6.8L motors, but there were just enough 4.6L Windsors built to make it interesting.

## ROMEO BLOCKS
### 1999-2000

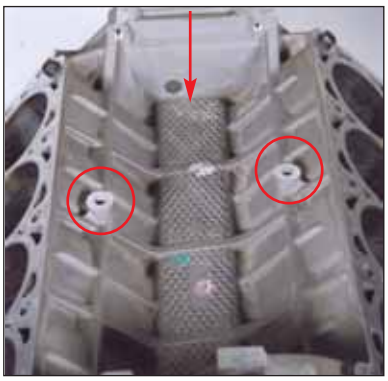
The XW7E block that was used from '99 through '00 was the same as the original F7AE block that first showed up in '97. It had the jackscrews for the main caps and a



*The bolt hole by the water pump cover was moved down about .500˝ on the 1L2E/3L2E aluminum block. There's an additional vent hole in the front of the block for an air passage that goes all the way through to the back of the motor, too.*



*The aluminum SOHC motor used in the Explorer and Expedition has the 2L1E-DE/2L2E-AD high mount front cover, but it's unique because one of the bolt holes was moved down about a 1/2 inch.*

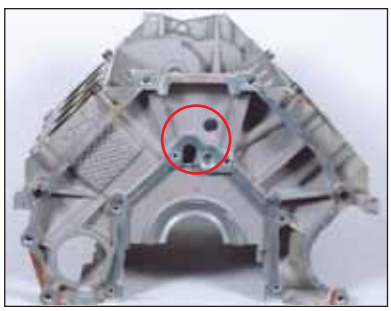


*The shallow valley in the aluminum block left room for the air passage that was added for crankcase ventilation. These blocks had two threaded bosses for the 8.0mm knock sensors, too.*

12.0 mm hole in the valley for the knock sensor.

### 2001-'04
### CAST IRON BLOCK

Ford continued to use the XW7E block through '04, but the



*The back of the aluminum block has a vent hole for the air passage that goes all the way to the front.*

front of the block was modified because they changed the timing set. Two of the dowel pins that had been used to locate the steel-backed, plastic chain guides found on the earlier Romeos were deleted when these engines started using the Windsor-style, all plastic chain guides beginning in '01. Just as a side note, the XW7E block was modified to provide more rod clearance for the Manley rods that were used in the Cobra motors '03-'04, but it still works for all the other car and truck applications.

### 2002-'04
### ALUMINUM BLOCK

The aluminum Romeo block was introduced in '02 for the all-new Explorer. It was used in the Explorer from '02 through '04 and it's been seen in a few '03-'04 Expeditions, according to some rebuilders. It's a 1L2E or 3L2E casting that's very similar to the XW7E cast iron Romeo block, but there are a few noticeable differences. The intake valley isn't quite as deep because there's a vent passage in the valley that connects the front of the block with the back of the block. There are two raised bosses for a pair of 8.0 mm knock sensors in the valley, too. And, Ford moved one of the holes for the front cover down about a 1/2 inch, just to see if we were paying attention.

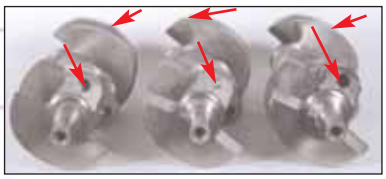
## WINDSOR BLOCKS
### 1999-'04

The F75E blocks that were used from '99-'04 were identical to the original F75E castings except that they had an 8.0 mm hole for the new knock sensor. The Windsor motor was used in the pickups along with the Mustang and the Expedition in '99, in the Mustang in '00, and in the F150 Supercrew, four door pickups from '01 through '04.

# Cranks

## ROMEO AND WINDSOR

There were two cranks used in these motors from '99 through '04 with a couple of variations. There's a light one and a heavy one, depending on the year, and they had six or eight bolt crank flanges, depending on the application and the year. The Romeos always had a



*There were a few F65E cranks that were balanced for the heavy rods so they have the deep holes in the counterweights, just like the 2C5E castings. You can see the difference if you compare the 2C5E (left) with the standard F65E (middle) and the F65E that's modified for the heavy rods (right).*

six-bolt flange, but the Windsors came both ways, so check the application charts to see when and where they were used.

### 1999-'01

The F65E crank that came out in '96 was used up through '01. We call it the "lightweight crank" because it had lighter counterweights for the lightweight rods that were used through '01. However, we have seen a F65E crank that was balanced for the heavy rods in a 2002 Explorer block. All of the balance holes were similar to the ones in the 2C5E crank and the balance was nearly the same as the 2C5E crank when we spun it up with the bobweights we used for the heavy rods. There may not be many of them out there, but putting a F65E "heavy crank" in a motor with light rods will cause a problem, so be sure to check it out before you make a mistake and get to do it over again.

### 2002-'04

The 2C5E crank showed up in '02 when the new, heavy duty rods were introduced. The casting number isn't always easy to read, but the crank is easy to identify because it has bull-nosed counterweights instead of the knife-edged ones found on all the F65E castings.

*The 2C5E crank (left) with the bull-nosed counterweights was introduced in 2002 along with the heavy rods. It's easy to tell the difference because the counterweights on the F65E castings (right) were always knife-edged.*

Be careful though, because all of the cranks for the 5.4L motors are bull-nosed, too, so be sure to check the stroke if you can't read the casting number.

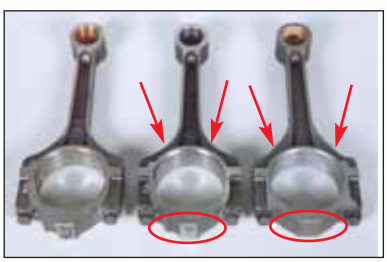
## Connecting Rods

There have been four different rods used in these engines, depending on when and where the engine was built.

### ROMEO RODS

### 1999-'01

The Romeo motors used a lightweight, press-fit rod (F1AE/F2AE) through '01. It usually weighed around 575 grams.



*The late, heavy rods (left and middle) have more meat on the big end than the early ones (right). Both versions came with and without pin bushings.*

### 2002-(BEFORE 1/2/02)

Ford put a heavy duty, press-fit rod that weighed around 615 grams in the Romeo motors in '02. The big end was beefed up, so all of the additional weight (35 to 40 grams) was rotating weight. It was a 2L1Z-6200-AA part number.

### 2002-(AFTER 1/2/02)- '04

The heavy rod was converted from a press-fit to a bushed design after 1/2/2002. It carried a 2C5Z-6200-AA part number.

### WINDSOR RODS

### 1999-'01

The Windsor motors had the lightweight rods from '99 through '01, too, but they were always bushed instead of press-fit like the Romeos. Apparently the engineers at the Windsor plant wanted all the bearing surface they could get for the wrist pins that were used in the truck motors.

### 2002 (BEFORE 1/2/02)

There were very few 4.6L Windsors built in '02, but they did get the heavy duty rods along with the heavy crank, just like the Romeos. The early '02 Windsors should have been press-fit, just like the early '02 Romeos, but we suspect that all the heavy rods that were used in the Windsor motors were bushed, because the Windsor rods were always bushed in the past so it doesn't seem likely that they changed their piston design to accommodate a press-fit rod for just a few months in early '02. In fact, some people have suggested that the Romeo plant switched over to the bushed rods to accommodate the Windsor plant and their requirement for a bushed rod, but we'll never know for sure.

### 2002 (AFTER 1/2/02)- '04

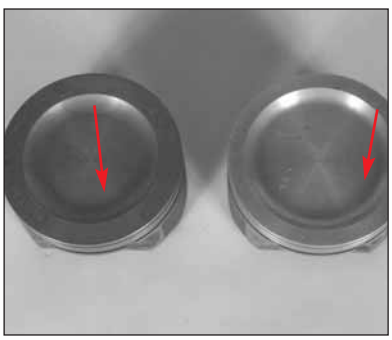
All of the 4.6L Windsors built after 1/2/02 had the heavy, bushed rods, even if some of the earlier ones didn't…

## Pistons

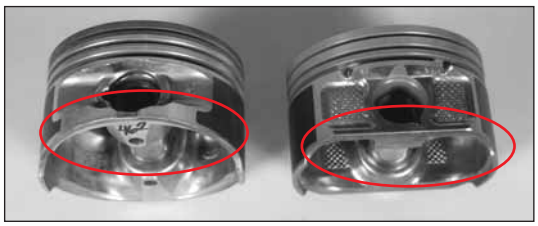
There have been two different pistons used in the 4.6L motors, one that has a shallow dish for the engines with the NPI heads and one that has a deeper dish for the engines for the PI heads. Both pistons came with and without pin locks, too, depending on the application. There's a slight difference in the design because the ones that were used up through '00 had slipper skirts and the ones that were used from '01 through '04 were a full-round design. There is a slight difference in weight (20-25 grams) between the two designs, but they appear to be interchangeable because Ford used them with both the light and heavy cranks.

### ROMEO PISTONS 1999-'00 NOT POWER IMPROVED

These engines had NPI heads with the big chambers so the pistons had a shallow dish and press-fit pins.



*The pistons for the "PI" motors (right) have a bigger dish than the ones for the "NPI" motors (left). Don't mix them up.*



*The original pistons had a slipper skirt (right), but the later ones were a full-round design so they're slightly heavier.*

### 2001-EARLY '02 POWER IMPROVED

The Romeo motors got the PI heads in '01 so the pistons came with a deeper dish because the PI chambers were smaller than the NPI chambers. These pistons were full-round, but they were still press-fit.

### LATE 2002-'04 POWER IMPROVED

These Romeos motors had the full-round, deep dish pistons, but they had pin locks now, because the rods were bushed for full-floating pins.

### WINDSOR PISTONS 1999 NOT POWER IMPROVED

Most of the '99 Windsors had NPI heads, so the pistons had the shallow dish, but they had pin locks because the Windsor rods were bushed for full-floating pins.

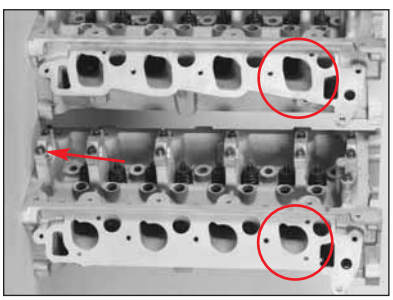
### 1999-'04 POWER IMPROVED

The PI heads with the small chambers were originally used on the Expedition and Mustang in '99, so the pistons had the deeper dish. All of the Windsor pistons had pin locks except for the early '02 motors that were supposedly built with the heavy, press-fit rods, but we're willing to bet that all the heavy rods for the Windsors were bushed, so all of these pistons probably had pin locks, too. The early pistons had slipper skirts and the later ones ('01-'04) were the full-round design.

## Heads

There have been four basic heads used on these engines including the Windsor NPI and PI along with the Romeo NPI and PI. Each version is pretty much the same, but there are a few subtle differences within each type that can get you in trouble.

### ROMEO HEADS 1999-'00 NOT POWER IMPROVED

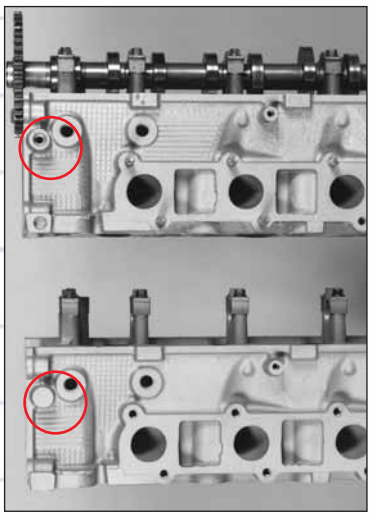


*The "power improved" (PI) Windsor heads (top) had square ports that were considerably bigger than the oval ports found on the "not powered improved" (NPI) heads. Note the individual cam caps on the Windsor head.*

The NPI heads with the oval ports and big chambers were used on all the Romeos through 2000. Look for a F5AE casting with ladder caps and the four 8.0x1.25 mm threaded holes on both ends of the heads.

### 2001-'04 POWER IMPROVED

Ford put the 1L2E/2L2E PI heads on the Romeo in '01. They have ladder caps, square ports and



*The 2L1E Windsor heads had an extra boss that was usually drilled and tapped for the high mount power steering pump in '02, but there are some early 2L1E castings that weren't drilled.*

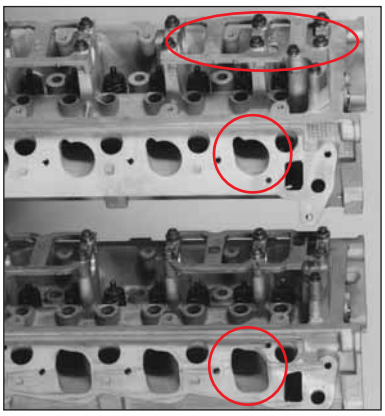
smaller chambers. They also have the extra bolt holes for the high mount power steering pump that was bolted directly to the left head using the two bolt bosses that are right behind the front cover and just below the rocker rail.

### WINDSOR HEADS
### 1999 NOT POWER IMPROVED

All the pickup trucks that were built in '99 had the F65E-BB/F75E NPI casting with the oval ports and big chambers. These Windsor heads can be identified by the individual caps, oval ports and the four 10.0 x 1.50 mm bolt holes on both ends of the heads.

### 1999-'01 POWER IMPROVED

The XL3E Windsor PI castings that originally came on the '99 Mustang and Expedition were used up through '01. They had individual caps and the 10.0 mm bolt holes on both ends along with the smaller chambers.



*The 2001 "PI" Romeo heads have the same square ports found on the Windsor "PI" heads in '99. Note the ladder caps that were used on the Romeo motors.*

### 2002-'04 POWER IMPROVED

The original PI Windsor heads were replaced by the 2L1E castings in '02. They had two extra bolt holes for the high-mount, power steering pump on the driver's side, just like the Romeo PI heads.

## Cams

Ford has used several cams for these engines, but we have narrowed it down to four basic combinations:

1) Romeo NPI
2) Romeo PI
3) Windsor NPI
4) Windsor PI

The specifications for the NPI/PI Romeo and Windsor cams are very similar, but the cams are different because the gears are pressed on the Windsors and bolted on the Romeos. The cam charts on page 44 spell it out in more detail along with the identification numbers, part numbers and applications. You may or may not want to consolidate as many of the cams as we do, so be sure to compare all the specifications before making your decision.

*The cam gears are bolted on the Romeo cams along a spacer, but they're pressed on all the Windsor cams.*

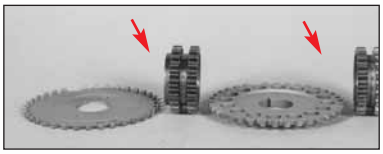
## Timing Components

### ROMEO
### 1999-'00

The chain guides on all the early Romeo engines had a steel backing and a plastic wear surface. They also used the thin crank gear (1.00″) and the thick (.200″), powered-metal reluctor wheel. The reluctor wheel we took off an early core had a F2LE-12A227-BB engineering number on it.

### 2001-'04

Ford made two changes to the timing set for Romeo in '01. 1) They switched to the Windsor all-plastic chain guides that were mounted differently, and, 2) they used a thicker crank gear (1.180″) along with a thinner (0.100″), stamped metal, reluctor wheel. The reluctor wheel we took off a later core had XW1E-12A227-AA stamped on it.



*In 2001, Ford starting using a thin, stamped reluctor wheel and a thick crank gear (left) instead of the thick reluctor wheel along with a thin crank gear (right). Be sure to use them as a pair.*

# Cars

## CROWN VIC/MARQUIS/TOWN CAR

| YEAR | VIN CODE | PART NO. | BLOCK | HEADS | CRANK | FT. COVER |
|---|---|---|---|---|---|---|
| ***'91-'92 (early '92)*** | W (Romeo) | F281-1-1-L | F1AE | F1AE (NPI) | F1AE (6 BOLT) | F1AE/F2AE |
| ***'92 (Mid-year)*** | W (Romeo) | F281-2-2-LA | F2VE/F4VE | F2AE/F4AE (NPI) | F1AE (6 BOLT) | F1AE/F2AE |
| ***'92-'95 (late '92)*** | W (Romeo) | F281-2-2-L | F2VE/F4VE | F2AE/F4AE (NPI) | F1AE (6 BOLT) | F3AE/F5AE |
| ***'96-'97*** | W (Romeo) | F281-3-3-LC | F65E-CC/F6VE F7VE | F5AE (NPI) | F65E (6 BOLT) | F6AE/F7AE F7ZE/F8ZE |
| ***'96*** | 6 (Windsor) | F281-4-5-LC | F65E-BB/F75E | F65E/F75E (NPI) | F65E (6 BOLT) | F6AE/F7AE F7ZE/F8ZE |
| ***'98-'99*** | W (Romeo) | F281-3A-4-LC | F7AE/ZW7E | F5AE (NPI) | F65E (6 BOLT) | F6AE/F7AE F7ZE/F8ZE |
| ***'00*** | W (Romeo) | F281-3A-4-LC2 | F7AE/XW7E | F5AE (NPI) | F65E (6 BOLT) | XR3E |
| ***'01*** | W (Romeo) | F281-8-7-LC | XW7E (w/o dowels) | 1L2E/2L2E (PI) | F65E (6 BOLT) | XR3E |
| ***'02-'04*** | W (Romeo) | F281-10-7-LC | XW7E (w/o dowels) | 1L2E/2L2E (PI) | 2C5E (6 BOLT) | XR3E/2W7E |

# Mustangs

| YEAR | VIN CODE | PART NO. | BLOCK | HEADS | CRANK | FT. COVER |
|---|---|---|---|---|---|---|
| ***'96-'97*** | X (Romeo) | F281-3-3-LC | F65E-CC F6VE/F7VE | F5AE (NPI) (w/o temp sensor hole) | F65E (6 BOLT) | F6AE/F7AE F7ZE/F8ZE |
| ***'98*** | X (Romeo) | F281-3A-4-LC | F7AE/XW7E | F5AE (NPI) (w/o temp sensor hole) | F65E (6 BOLT) | F6AE/F7AE F7ZE/F8ZE |
| ***'99 (Early)*** | X (Windsor) | F281-7-6-LM | F65E-BB F75E | XL3E (PI) | F65E (8 BOLT) | F7ZE/F8ZE F6AE/F7AE |
| ***'99-'00 (99 Late)*** | X (Windsor) | F281-7-6-LC | F65E-BB F75E | XL3E (PI) | F65E (8 BOLT) | XR3E/2W7E |
| ***'01*** | X (Romeo) | F281-8-7-LC | XW7E (w/o dowels) | 1L2E/2L2E (PI) | F65E (6 BOLT) | XR3E/2W7E |
| ***'02-'04*** | X (Romeo) | F281-10-7-LC | XW7E (w/o dowels) | 1L2E/2L2E (PI) | 2C5E (6 BOLT) | XR3E/2W7E |

# Trucks

| YEAR | VIN CODE | PART NO. | BLOCK | HEADS | CRANK | FT. COVER |
|---|---|---|---|---|---|---|
| ***'97-'00*** | W (Romeo) | F281-3A-4-LT | F7AE/XW7E | F5AE (NPI) | F65E/F65E (6 BOLT) | F65E |
| ***'97-'98 W/O OIL COOLER*** | W (Romeo) | F281-3-4-LT | F65E-CC/F6VE F7VE | F5AE (NPI) | F65E (6 BOLT) | F65E |
| ***'97-'99*** | 6 (Windsor) | F281-4-5-LT | F65E-BB/F75E | F65E/F75E (NPI) | F65E (6 BOLT) | F65E |
| ***'97-'99*** | 6 (Windsor) | F281-5-5-LT | F65E-BB/F75E | F65E/F75E (NPI) | F65E (8 BOLT) | F65E |
| ***'01 EX SUPERCREW*** | W (Romeo) | F-281-8-7-LT | XW7E | 1L2E/2L2E (PI) | F65E (6 BOLT) | F65E |
| ***'01 F-150 SUPERCREW*** | W (Windsor) | F281-6-6-LT | F65E-BB/F75E | XL3E (PI) | F65E (6 BOLT) | F65E |
| ***'02 F-150 SUPERCREW*** | W (Windsor) | F281-13-8-LT | F65E-BB/F75E | 2L1E (PI) | 2C5E (6 BOLT) | 2L3E-AB |
| ***'02-'04 F-150 PICKUPS ('04 HERITAGE) EX SUPERCREW*** | W (Romeo) | F281-10-7-LT1 | XW7E | 1L2E/2L2E (PI) | 2C5E (6 BOLT) | 2L3E-AB |
| ***'02-'04 F-150 SUPERCREW ('04 HERITAGE)*** | W (Windsor) | F281-14-8-LT | F65E-BB/F75E | 2L1E (PI) | 2C5E (8 BOLT) | 2L3E-AB |
| ***'04 F-150 NEW BODY STYLE*** | W (Romeo) | F281-10-7-LT | XW7E | 1L2E/2L2E (PI) | 2C5E | 3L3E |

## Econolines

| YEAR | VIN CODE | PART NO. | BLOCK | HEADS | CRANK | FT. COVER |
|---|---|---|---|---|---|---|
| '97-'98 | 6 (Windsor) | F281-4-5-LT | F65E-BB/F75E | F65E/F75E (NPI) | F65E (6 BOLT) | F65E |
| '97-'98 | 6 (Windsor) | F281-5-5-LT | F65E-BB/F75E | F65E/F75E (NPI) | F65E (8 BOLT) | F65E |
| '99-'00 | W (Romeo) | F281-3A-4-LT | F7AE/XW7E | F5AE (NPI) | F65E (6 BOLT) | F65E |
| '01 | W (Romeo) | F-281-8-7-LT1 | XW7E | 1L2E/2L2E (PI) | F65E (6 BOLT) | 2L3E-AB |
| '02-'04 | W (Romeo) | F281-10-7-LT1 | XW7E | 1L2E/2L2E (PI) | 2C5E (6 BOLT) | 2L3E-AB |

## Expeditions

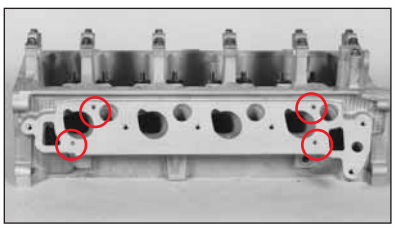
| YEAR | VIN CODE | PART NO. | BLOCK | HEADS | CRANK | FT. COVER |
|---|---|---|---|---|---|---|
| '97-'98 4X4 | 6 (Windsor) | F281-4-5-LT | F65E-BB/F75E | F65E/F75E (NPI) | F65E (6 BOLT) | F65E |
| '97-'98 4X2 & 4X4 | W (Romeo) | F281-3A-4-LT | F7AE/XW7E | F5AE (NPI) | F1AE/F65E (6 BOLT) | F65E |
| '99 | 6 (Windsor) | F281-7-6-LT | F65E-BB/F75E | XL3E (PI) | F65E (8 BOLT) | F65E |
| '00 | W (Romeo) | F281-3A-4-LT | XW7E | F5AE (NPI) | F65E (6 BOLT) | F65E |
| '01 | W (Romeo) | F-281-8-7-LT | XW7E | 1L2E/2L2E (PI) | F65E (6 BOLT) | F65E |
| '02 | W (Romeo) | F281-10-7-LT | XW7E | 1L2E/2L2E (PI) | 2C5E (6 BOLT) | 2L3E-AB |
| '03-'05 | W (Romeo) | F281-10-7-LT | XW7E | 1L2E/2L2E (PI) | 2C5E (6 BOLT) | 3L3E |
| '03-'05 | W (Romeo) | F281-12-7-LT | 1L2E/3L2E (ALUMINUM) | 1L2E/2L2E (PI) | 2C5E (6 BOLT) | 2L1E 2L2E |

## Explorers

| YEAR | VIN CODE | PART NO. | BLOCK | HEADS | CRANK | FT. COVER |
|---|---|---|---|---|---|---|
| '02-'04 | W (Romeo) | F-281-12-7-LT | 1L2E/3L2E (ALUMINUM) | 1L2E/2L2E (PI) | 2C5E (6 BOLT) | 2L1E 2L2E |

*The steel-backed, plastic chain guides were used on the Romeo motors through 2000, but they switched to the all plastic, Windsor guides in '01.*

*Ford switched to a plastic tensioner on the 4.6L motors (right) instead of the cast iron version (left) so they're not rebuildable anymore.*



*Some of the dowel holes for the intake manifold gaskets were on the top and some were on the bottom, so we drill the second set of holes on every head to make sure the gasket always fits.*

### WINDSOR
### 1999-'04

The Windsor motors used an all plastic chain guide from '96 through '04, so the only difference in the Windsor timing set was the change to the thick crank gear and the thin reluctor wheel in '01.

## Summary

That's the story on all the major components, but it still doesn't tell which ones were used for any particular vehicle, so we have included some charts along with this article that do show which castings were used for each specific application, year by year.

You may notice some surprises when you read over them. We were surprised to see that the Expedition had a PI Windsor motor in '99, a NPI Romeo in '00, and a PI Romeo in '01. And we were even more surprised to discover that there were PI Windsor motors in the '01-'04 F150 Super crew pickups and that they came with a Romeo VIN code, especially since there weren't supposed to be any 4.6L Windsors built after 2000.

## 4.6L Front Covers

### Cars

| YEAR | CASTING NUMBER | OEM PART NUMBER |
|---|---|---|
| 91-92 | F1AE/F2AE | F1AZ-6019-A |
| 92-95 | F3AE/F5AE | F5AZ-6019-A |
| 96-99 | F6AE/F7AE | F8ZZ-6019-CA |
| | F7ZE/F8ZE | |
| 00-03 | XR3E | XR3Z-6019-BA |
| | 2W7E | 2W7Z-6019-AA |

### Mustang

| YEAR | CASTING NUMBER | OEM PART NUMBER |
|---|---|---|
| 96-99 (early) | F6AE/F7AE | F8ZZ-6019-CA |
| | F7ZE/F8ZE | |
| 99 (late)-04 | XR3E | XR3Z-6019-BA |
| | 2W7E | 2W7Z-6019-AA |

### Trucks

| YEAR | CASTING NUMBER | OEM PART NUMBER |
|---|---|---|
| 97-01 | F65E | F65Z-6019-AB |
| 02-04 (Heritage) | 1L2E/2L3E-AB | 2L3Z-6019-AA |
| 04-05 (New Body) | 3L3E | 3L3Z-6019-AA |

### Vans

| YEAR | CASTING NUMBER | OEM PART NUMBER |
|---|---|---|
| 97-2000 | F65E | F65Z-6019-AB |
| 01-04 | 1L2E/2L3E-AB | 2L3Z-6019-AA |

### Expedition

| YEAR | CASTING NUMBER | OEM PART NUMBER |
|---|---|---|
| 97-01 | F65E | F65Z-6019-AB |
| 02 | 1L2E/2L3E-AB | 2L3Z-6019-AA |
| 03-05 (Cast Iron Block) | 3L3E | 3L3Z-6019-AA |
| 03-05 (Aluminum Block) | 2L1E-DE/2L2E-AD | 2L2Z-6019-AA |

### Explorer

| YEAR | CASTING NUMBER | OEM PART NUMBER |
|---|---|---|
| 02-04 | 2L1E-DA/2L2E-AD | 2L2Z-6019-AA |

**With that in mind, here's the disclaimer:** Over the past several years, we've spent a lot of time researching all the applications so we thought the charts were pretty accurate, but over the past few months, we have gotten some new information, so we've corrected them accordingly. The charts included with this article correct some typos and incorrect information contained in previous versions of this article, particularly with regard to the front covers and crankshafts. This is the most up-to-date information we know of, but if you have any corrections or clarifications to what is provided here, let us know.

Here are some things you need to know before you do it wrong the first time.

### RING SETS

The Romeo and Windsor motors used different ring sets so the top ring grooves weren't the same. Don't mix them up.

*You can use either a Timesert or the factory stud to accommodate the 8.0 mm knock sensor that was used on all the "PI" motors.*

### INTAKE GASKETS

The holes for alignment pegs for the intake gaskets have been moved from the inside of the port to the outside and back again on some of these engines, so it's hard to know which intake gasket set to send with the long block unless you physically check both of the heads before you ship the motor. We have eliminated the problem by drilling both sets of holes on the intake surface so either gasket will work.

### CRANK GEARS AND RELUCTOR WHEELS

Be sure to use the matching crank gear and reluctor wheel. The engine won't start and run if you are using the thin crank gear along with the thin reluctor wheel. Installing the thick crank gear with a thick reluctor will crack the front cover when you bolt it on and lock up the engine, too.

### KNOCK SENSOR HOLES

It appears that all the motors with the PI heads used the new style knock sensor that was held on by an 8.0 mm bolt or stud, so make sure all the PI Windsors, starting in '99, and all the PI Romeos, beginning in '01, have an 8.0 mm hole or stud.

The F75E Windsor block came with both 8.0 mm and 12.0 mm threads in the valley, so you must use a block with the right bolt hole for the specific application. Some rebuilders avoid the problem by drilling and tapping all the Windsor blocks to 12.0 mm and sending a thread insert along with each engine. If you choose to do this, we would recommend the "Bigsert" made by Timesert (p/n 58121) that reduces the threads from 12.0 mm to 8.0 mm.

*You can see that cam snout has slipped inside the tube because it's galled on the O.D. The guys at Gopher Motors took this cam out of a motor that bent all the valves on the right bank.*

All of the cast iron Romeo blocks we've seen have 12.0 mm threads, so you can either send the Timesert with the motor or include the OEM

stud (p/n W704602-S309) that has 12.0 mm threads on one end and 8.0 mm threads on the other end.

### CAMS

We've seen some Romeo cams that have had the keyways in an unusual location relative to the number one lobe. We couldn't find any cam gears with different keyways, so we were at a loss until we talked to the guys at Gopher Motors. They heated a cam red hot, removed the snout and discovered that it was galled on the outside because it had spun on the inside of the tube when the engine locked-up and bent all the valves on one bank. With that in mind, be sure to check the location of the keyway relative to the number one lobe before reusing any of these cams.

**ROMEO CAM CHART**

| CAM IDENTIFICATION | OEM PART NUMBER | COMMENTS |
|---|---|---|
| F1AE-6250-AA<br>F2AE-6250-AA<br>F6AE-6250-AA | F2AZ-6250-A<br>F6AZ-6250-EA<br>F6AZ-6250-CA | **RIGHT HAND ROMEO CAM**<br>* CAM GEAR IS BOLTED ONTO THE CAM.<br>* FOR ROMEO WITH NPI HEADS THAT HAVE OVAL INTAKE PORTS. |
| F1AE-6A274-AA<br>F2AE-6A274-AA<br>F6AE-6A274-BA | F2AZ-6250-B<br>F6AZ-6250-DA | **LEFT HAND ROMEO CAM**<br>* CAM GEAR IS BOLTED ONTO THECAM.<br>* FOR ROMEO WITH NPI HEADS THAT HAVE OVAL INTAKE PORTS. |
| 1L2E-6250-DA | 1L2Z-6250-AA | **RIGHT HAND ROMEO CAM**<br>* CAM GEAR IS BOLTED ONTO THE CAM.<br>* FOR ROMEO WITH "POWER IMPROVED" HEADS THAT HAVE SQUARE INTAKE PORTS. |
| 1L2E-6A274-CA | 1L2Z-6250-DA | **LEFT HAND ROMEO CAM**<br>* CAM GEAR IS BOLTED ONTO THE CAM.<br>* FOR ROMEO WITH "POWER IMPROVED" HEADS THAT HAVE SQUARE INTAKE PORTS. |

**WINDSOR CAM CHART**

| CAM IDENTIFICATION | OEM PART NUMBER | COMMENTS |
|---|---|---|
| F65E-6251-BA | F6AZ-6250-AA<br>F7TZ-6250-BA | **RIGHT HAND WINDSOR CAM**<br>* CAM GEAR IS PRESSED ONTO THE CAM<br>* FOR WINDSOR WITH NPI HEADS THAT HAVE OVAL INTAKE PORTS |
| F65E-6C255-AA | F6AZ-6250-BA | **LEFT HAND WINDSOR CAM**<br>* CAM GEAR IS PRESSED ONTO THE CAM.<br>* FOR WINDSOR WITH NPI HEADS THAT HAVE OVAL INTAKE PORTS. |
| XL3E-6251-A8C | XL3Z-6250-AA | **RIGHT HAND WINDSOR CAM**<br>* CAM GEAR IS PRESSED ONTO THE CAM.<br>* FOR WINDSOR WITH "POWER IMPROVED" HEADS THAT HAVE SQUARE INTAKE PORTS. |
| XL3E-6C255-A8C | XL3Z-6250-CA | **LEFT HAND WINDSOR CAM**<br>* CAM GEAR IS PRESSED ONTO THE CAM.<br>* FOR WINDSOR WITH "POWER IMPROVED" HEADS THAT HAVE SQUARE INTAKE PORTS. |

## Conclusion

The two valve SOHC 4.6L has been one of the most popular engines in many of Ford's cars, trucks, vans and sport utilities since 1996. The three valve engine that's used in the Mustang, Explorer, Mountaineer and some pickups today is doing an exceptional job, so it's inevitable that it will replace the two valve motor, probably within the next year or two, but that doesn't change the fact that there are five million two valve motors out there, just waiting to come see us. **EB**

*Sometimes the snout slips on the barrel of the cam so the keyway ends up in the wrong place. Be sure to verify the location of the keyway before reusing any of these cams.*

Doug Anderson is President of Grooms Engines, Parts, Machining, Inc., located in Nashville, TN. He has authored numerous technical articles on engine rebuilding for *Engine Builder* magazine for more than 16 years. Anderson has also made many technical presentations on engine building at AERA and PERA conventions and seminars.