MECHANICAL ENGINEERING DIESEL TECHNOLOGY

The Definitive Engineering Guide to Cummins NT855 and Big Cam Torque Specifications

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The Legacy and Engineering Excellence of the Cummins NT855 Series

The **Cummins NT855**, particularly the **Big Cam** variants, represents a watershed moment in the history of diesel engineering. Introduced in the 1970s and refined through the 1980s and 90s, the 855-cubic-inch (14-liter) inline-six engine became the backbone of the heavy-duty trucking, marine, and industrial sectors. Its reputation for durability is matched only by its modularity, allowing it to be adapted for everything from long-haul semi-trucks to standby power generators. To maintain these engines at peak performance, a deep understanding of their mechanical architecture—specifically the **torque specifications**and assembly tolerances—is mandatory for any diesel technician or engineer.

Understanding the transition from the "Small Cam" to the "Big Cam" is vital. The "Big Cam" designation refers to the increase in the camshaft diameter from 2.0 inches to 2.5 inches. This engineering shift allowed for higher injection pressures and shorter injection durations, which significantly improved fuel efficiency and reduced emissions during an era of tightening environmental regulations. This guide provides an exhaustive analysis of the **Cummins N855 Big Cam (I-IV)**torque values, assembly procedures, and the physics of fastening components in high-compression diesel environments.

Core Technical Specifications: The 14-Liter Powerhouse

Before diving into specific bolt torques, we must establish the baseline physical parameters of the NT855 engine family. These metrics define the thermal and mechanical stresses that the fasteners must withstand.

Metric	Specification Value		
Configuration	Inline 6-Cylinder, 4-Stroke Diesel	Displacement	14.0 Liters (855 Cubic Inches)
Bore and Stroke	5.5 in x 6.0 in (140 mm x 152 mm)		
Aspiration	Turbocharged (Aftercooled in later models)		
Horsepower Range	280 HP to 480 HP (Diesel) / 147-290 HP (Gas)		
Compression Ratio	14.0:1 to 17.0:1 (Variation by Series)		
Firing Order	1-5-3-6-2-4		

The Physics of Fastening: Why Torque Accuracy Matters

In a high-displacement engine like the **Cummins NT855**, fasteners are subjected to extreme cyclic loading. Cylinder head bolts, for instance, must counteract peak firing pressures that can exceed 2,000 PSI. If a bolt is undertorqued, the clamping force will be insufficient to maintain the seal of the head gasket, leading to combustion gas leakage and catastrophic "blown" gaskets. Conversely, overtorquing can exceed the **elastic limit**of the bolt, causing it to undergo plastic deformation (permanent stretching) or shear failure.

The assembly of the Big Cam engine utilizes **multi-step torque sequences** and, in some instances, **Torque-plus-Angle**(TPA) methods. TPA is particularly effective because it minimizes the friction-induced variables associated with torque-only measurements, ensuring that the bolt is stretched to a precise tension within its elastic range.

The Critical Trinity: Main Bearings, Connecting Rods, and Cylinder Heads

The most vital structural fasteners in the NT855 are those securing the crankshaft, the pistons, and the cylinder heads. Failure in any of these areas usually results in total engine loss.

1. Main Bearing Torque Procedures

The main bearings support the crankshaft. For the 1-inch diameter bolts typically found in the NT855 Big Cam series, a repetitive procedure is used to ensure the bearing caps are perfectly seated and the bolts have achieved stable tension.

- Initial Step: Torque to 110 ft-lbs (149 N•m).
- Second Step: Torque to 210 ft-lbs (285 N•m).
- Final Step: Torque to 305 ft-lbs (414 N•m).
- The "Settling" Process: After reaching the final value, the bolts should be loosened completely and the sequence repeated. This ensures that any surface irregularities in the threads or under the bolt head are smoothed out, resulting in a more accurate final clamping force.

2. Connecting Rod Torque Specifications

The connecting rods in a **Cummins 855**must endure rapid acceleration and deceleration with every stroke. The Big Cam series typically utilizes a two-step approach for the rod bolts to prevent distortion of the rod cap.

- Step 1: 75 ft-lbs (102 N•m).
- Step 2: 170 ft-lbs (230 N•m).

It is essential to use high-quality **molybdenum disulfide lubricant** on the threads and the underside of the bolt head to ensure the torque reading reflects actual tension rather than thread friction.

3. Cylinder Head Torque and Sequence

The NT855 uses three separate cylinder heads (each covering two cylinders). This design helps manage thermal expansion across the long block. The torque sequence must follow a specific pattern (usually starting from the center and spiraling outward) to ensure even distribution of the gasket compression.

Step	Torque Value (ft-lbs)	Additional Requirement
Step 1	100 ft-lbs	Ensure threads are clean and lubricated
Step 2	200 ft-lbs	Follow the spiral sequence
Step 3	300 ft-lbs (Series III/IV)	Earlier models may vary; see manual
Final (Alt)	220 ft-lbs	+ 90-degree turn (Angle Method)

Valve and Injector Adjustments: The "Top Stop" System

A unique feature of the Cummins 855 is the **PT (Pressure-Time)**fuel system and the requirement for precise valve and injector overhead settings. Incorrect settings here lead to poor fuel economy, excessive smoke, and valvetrain wear.

Inlet and Exhaust Valve Clearances

Valves must be set when the engine is **cold**(less than 140°F / 60°C). The clearance allows for the expansion of the metal components as they reach operating temperature.

- Inlet Valve Clearance: 0.011 inches (0.28 mm).
- Exhaust Valve Clearance: 0.023 inches (0.58 mm).

Top Stop Injector Settings

The **Top Stop**injector design was introduced to improve the reliability of the mechanical injection system. The setting is measured in torque rather than travel distance. Using a precise inch-pound torque wrench is non-negotiable for this procedure.

- Setting Value: 0.7 N•m or 6.0 in-lb.
- Mechanism: The adjustment is made on the injector rocker lever to ensure the injector plunger is properly seated at the top of its stroke, preventing carbon build-up and ensuring consistent fuel metering.

Evolution of the Big Cam: Series I through IV

The NT855 underwent four major iterations under the Big Cam banner, each with subtle changes in technical requirements and cooling configurations.

Big Cam I and II

These early versions focused on the transition to the larger 2.5-inch camshaft. They utilized standard high-flow cooling systems and traditional head bolt torque specs. These are often found in vintage heavy-haul trucks and are praised for their simplicity.

Big Cam III

Introduced in the early 1980s, the Big Cam III emphasized weight reduction and further fuel efficiency. It featured a more refined turbocharging system and changes to the air intake manifolds. Torque specs for the main bearings remained consistent, but variations in the flywheel housing bolts were introduced.

Big Cam IV and the "Low Flow" Revolution

The Big Cam IV represented a significant departure in cooling philosophy. Cummins moved to a **Low Flow Cooling (LFC)** system, which utilized a two-pass radiator and a different thermostat arrangement to maintain more consistent engine temperatures. This reduced parasitic power loss from the water pump and improved emissions. When working on a BC IV, technicians must ensure that the specific head gaskets designed for low-flow water passages are used, as standard gaskets will cause immediate overheating.

Practical Implementation: A Field Guide to Assembly

When performing a mid-life "in-frame" overhaul or a complete out-of-frame rebuild, technical writers and senior mechanics emphasize the following procedural steps:

1. Component Cleaning and Inspection

Before applying a single ft-lb of torque, all mating surfaces must be "surgically" clean. Use a chase tap to clean the internal threads of the engine block. Debris at the bottom of a bolt hole can cause **hydraulic locking** when the bolt is tightened, leading to a cracked block or a false torque reading.

2. Liner Protrusion (Cylinder Sleeves)

The NT855 uses wet sleeves (liners). Before installing the cylinder heads, you must measure the **liner protrusion**. The liners should sit 0.003 to 0.006 inches above the deck of the block. If the protrusion is uneven, the head gasket will fail regardless of whether the head bolts are torqued correctly.

3. Lubrication Standards

Never torque "dry" unless specifically directed by the OEM manual. Use **engine oil** for head bolts and **moly-lube** for connecting rods. The goal is to achieve a consistent coefficient of friction so that the torque wrench reading accurately translates to bolt stretch.

Troubleshooting Common Failures in the NT855

Despite their ruggedness, the 855 series is susceptible to specific failure modes if torque or maintenance specs are ignored.

Cylinder Head Cracking

Often caused by overheating or improper torque sequences. Cracks usually appear between the valve seats. This is particularly common in Big Cam IV engines where the LFC system has been improperly maintained, leading to air pockets in the cooling jacket.

Main Bearing "Spinning"

If the main bearing caps are not torqued using the "loosen and repeat" method, the bearing crush may be insufficient. This allows the bearing shell to rotate (spin) within the housing, destroying the crankshaft and the block's main web.

Injector Linkage Wear

If the 6.0 in-lb "Top Stop" setting is not maintained, the mechanical linkage (pushrods and rockers) will experience accelerated wear, leading to "retarded" injection timing, high exhaust gas temperatures (EGTs), and melted piston crowns.

The Critical Role of Precision in Diesel Engineering

The **Cummins NT855 Big Cam** remains a testament to mechanical engineering where power is derived from displacement and heavy-duty iron. However, the sheer scale of these components demands a level of precision that mirrors aerospace standards. For the technical writer or the lead engineer, documenting these values is not merely about providing a list of numbers; it is about conveying the importance of the **clamping force** and the **metallurgical limits** of the fasteners.

By adhering to the multi-step torque sequences for the main bearings (110/210/305 ft-lbs), the connecting rods (75/170 ft-lbs), and the specialized valve adjustments (0.011/0.023 in), operators can ensure these engines continue to run for millions of miles. The Big Cam's evolution from the standard cooling of the 1970s to the sophisticated Low Flow Cooling of the late 80s demonstrates a commitment to iterative improvement—a philosophy that must be matched by the precision of the technicians who service them today.

As we move further into the era of electronic controls and high-pressure common rail systems, the mechanical purity of the **NT855**serves as a foundational study in diesel mechanics. Whether used in a vintage Peterbilt, a marine tug, or a backup generator for a hospital, the torque specifications outlined here are the primary safeguard against mechanical failure and the key to unlocking the legendary longevity of the Cummins 14-liter engine.

Tags: #Cummins NT855 #Big Cam Torque #Diesel Engine Specs #Engine Overhaul #Heavy Duty Mechanics