WHY DO VALVE HEADS BREAK OFF

Quick Reference Guide.

There are many causes pertaining to valve head breakage. However, the two primary operating conditions are:

1. MECHANICAL BREAKAGE - BRITTLE AND FATIGUE FRACTURES.

A Piston crown contacting valve - shear impact

1 Block cut short
2 No spacer plate gasket
3 No head gasket
4 Low liner Protrusion
5 Connecting rod sized wrong
6 Overspeeding
7 Loss of valve adjustment
8 Excessive valve head protrusion
9 Excessive valve stem height
10 Ingestion of foreign material
11 Incorrect parts application
12 Improperly located line bore, etc

B Improper installation of valve seat or guide, including bending loads.

1 Valve seat not flush with seat counterbore
2 Valve seat not parallel with guide
3 Guide not concentric with seat
4 Excessive stem to guide clearance
5 Worn out crossheads or rockers
6 Worn out rocker bushins
7 Valve seat angle not matchining valve face angle
8 Incorrect parts application

Note: Proper installation of seats and guides can be verified with a seat/guide runout gauge.

2. VALVE OVERHEATING, THERMAL FATIGUE, THERMAL BREAKAGE.

A Overfueling, increased combustion temperatures and presssure which increae coolant temperatures.

1 Increased fuel pump pressures.
2 Incorrect injection timing.
3 Incorrect main gear timing.
4 Incorrect rack setting.
5 Fuel contamination affecting nozzel atomization.
6 Inoperative air/fuel ratio valve.
7 Restricted fuel return.
8 Volatile fuel additives, etc.

B Fresh air and exhaust systems, same conditions as overfueling.

1 Fresh air intake systems, same conditions as overfueling. Not enough fresh air to properly balance fuel/air ratio.
2 Exhaust restrictions. Not enough flow to allow enough fresh air to enter the combustion chamber. Compustion engines can only intake as much air as they can exhaust.

SPECIAL NOTE:

Exhaust restriction has an extremely compounding effect on engine valves. Today's valves are designed to withstand temperatures from 1,000º to 1,500º F or more. At the time of combustion (a few milliseconds), combustion temperatures may reach as high as 3,000º to 5,000º F. The fresh air and the cooling system are the agents needed to cool the valves by transferring one third of the valve head heat through the seat, which will maintain valve temperatures within their design limits. If the exhaust system is not able to pass one third of the super heated exhaust, the super heated combustion gases are held within the combustion chamber, overheating the components and the cooling system beyond their engineered limits. Subsequently, components failure is inevitable.

As you can see, in many cases, valve breakage can be caused by a combination of conditions.

VALVE FAILURES NOT RELATED TO OPERATING CONDITIONS:

1. Mishandling and/or dropping valves.
2. Nicks in the fillet radius.
3. Packaging problems.
4. Eroded valve stems, stock affeted by moisture.
5. Valves damaged by Shipper.
6. Cylinder Head packaging - Shipper bending valve stems.
7. Dropping head on cylinder block.
8. Incorrect parts application.
9. Incorrect valve material per application.
10. Incorrect seat material.

TECH NOTE:

Our experiance shows the number one failure is the re-use of old, fatigued valves, seats and guides. Valve head faces and seats experience thousands of cyclic loads and combustion pressures up to 50,000 pounds. During an engine's service life, combustion pressures will naturally drop until the time of rebuild, at which time the combustion pressures are renewed. However, the old valves have fatigued and are now expected to withstand renewed combustion pressures.

The number two cause of valve failures is incorrect valve and seat materials. There are many different materials on the market today. It is very important to know the materials that have proven themselves per application.

Reports from the field show that an average of three out of every ten engines rebuilt with re-used valve train components experience failures. This relates to a 30% failure average which is much too high for today's customer demands.

Commonly used materials by quality suppliers. Materials listed are for the most popular applications.

Valves - Diesel Engines:
EV16 (23-8N) head material, with hard face sealing surface Stellite Grade 6. SAE 4140 stem material which is chrome plated. Valve stem ends are induction hardened to the area below lock grooves.
Seat insert - Diesel Engines
Inconel (nickel based materials)

Valves - Natural Gas Engines:
EV16 (23-8N) material with hard face sealing surface.
Seat insert - Natural Gas Engines
Inconel (nickel based materials)

Some suppliers are using EV8 (21-4N) or substandard valve materials without a hard face sealing surface. Other suppliers are using tool steel and low cobalt seat materials for both diesel and natural gas applications. Incompatible materials will cause premature wear and/or failures.