Baker Hughes

IADC dull grading system

Fixed cutter bits

Introduction

Accurate dull grading analysis improves the ability of Engineers to make decisions. This may then help to increase drilling efficiency while lowering drilling costs. An accurate dull grade gives you a good idea of how the hole was drilled. Careful inspection of the dull cutting structure and bearings also lets you know the characteristics that can affect the next bit selection, break-in procedures, and operating practices.

The IADC Dull Grading System Chart describes eight factors to dull grade bits. The first four spaces describe the cutting structure. The fifth space—B—refers to bearing seals, which apply to roller cone bits rather than fixed cutter. This space always is marked with an X when you're dull grading fixed cutter bits.

The industry has developed dull grading symbols that simplify this important function. These symbols can be used for all bit types, including

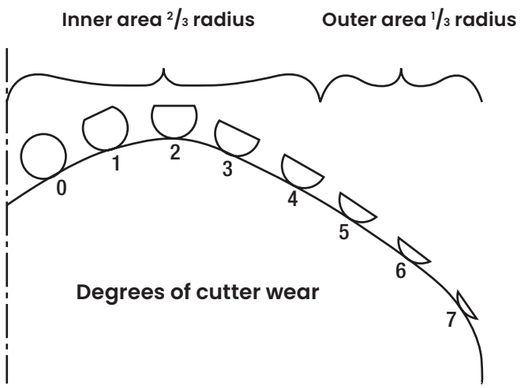
- TCI and steel tooth journal-bearing bits
- TCI and steel tooth sealed-ball and roller bits
- Nonsealed bearing bits
- Natural diamond bits
- PDC bits
- Impreg bits

Inner/Outer rows

The first two spaces on the dull grading system chart indicate the inner and outer row condition using a linear scale from 0 to 8. Zero represents no wear while 8 means no usable cutter life remains. Four means 50% wear.

IADC dull grading system chart

Cutting structure				B	G	Remarks	
Inner rows	Outer rows	Dull characteristics	Location	Bearing seals	Gauge $^{1}/_{16}$-in.	Other characteristics	Reason pulled
2	6			X			



Record the average amount of wear. As shown here, $^{2}/_{3}$ of the radius represents the inner rows. The five cutters in these areas would be graded 2. This is calculated by averaging the individual grades for each cutter in the area:

$$\frac{(4 + 3 + 2 + 1 + 0)}{5} = 2$$

The average for the outer area is calculated the same:

$$\frac{(5 + 6 + 7)}{3} = 6$$

Six would be the average wear gradient for the outer area. Record the results on the dull grading chart.

Dull characteristics/Other characteristics

The third and seventh spaces on the dull grading system chart are for noting the most prominent physical changes from the bit's new condition. The codes are listed below

PDC dull characteristics

BT – broken teeth/cutters

BU – balled up

CR– cored

CT – chipped teeth/cutters

ER – erosion

HC – heat checking

JD – junk damage

LN – lost nozzle

LT – lost teeth/cutters

NO – no major/other dull characteristics

PN – plugged nozzle/ flow passage

RO – ringout

WO – washed out

WT – worn teeth/cutters

Location

The fourth space on the dull grading system chart indicates the primary dull characteristics noted in the third space on the chart. Four possible fixed cutter bit profiles are shown in Figure 3 with the codes used to identify commonly referred to locations on the bit. These codes indicate the location of the noted dull characteristics.

Fixed cutter bit profiles

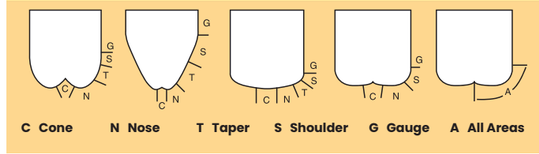


Figure 3.

Gauge

The sixth space on the dull grading system chart records the bit's gauge condition. Record an I if the bit is in gauge. Otherwise, the amount the bit is undergauge is recorded to the nearest 1/16. See Figure 4 for specific undergauge markings.

Gauge condition

Code	Explanation
I	In gauge
$^{1}/_{16}$	Undergauge up to $^{1}/_{16}$ in.
$^{2}/_{16}$	Undergauge $^{1}/_{16}$ in. to $^{1}/_{8}$ in.
$^{3}/_{16}$	Undergauge $^{1}/_{8}$ in. to $^{3}/_{16}$ in.
$^{4}/_{16}$	Undergauge $^{3}/_{16}$ in. to $^{1}/_{4}$ in.

Figure 4.

Reasons pulled

BHA – change bottomhole assembly

CM – condition mud

CP – core point

DMF – downhole motor failure

DP – drill plug

DSF – drillstring failure

DST – drillstem testing

DTF – downhole tool failure

FM – formation change

HP – hole problems

HR – hours on bit

LOG – run logs

PP – pump pressure

PR – penetration rate

RIG – rig repair

TD – total depth/CSG depth

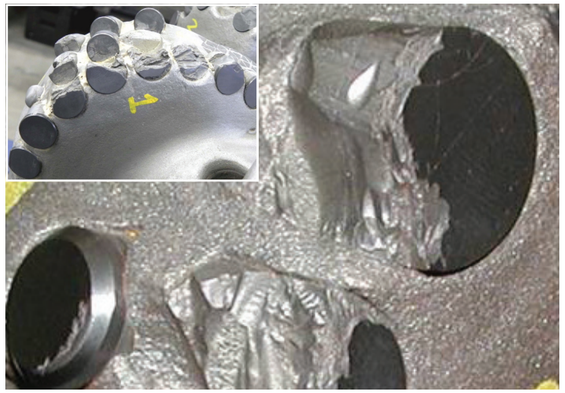
TQ – torque

TW – twist off

WC – weather conditions

WO – washout drill string

Dull characteristics



(BT) Broken Teeth/Cutters

A cutter that is broken flush or nearly flush to the diamond table and carbide substrate.

Cause
Operating parameters; vibration; junk damage; high-impact loading, formation too hard for bit; stick-slip.

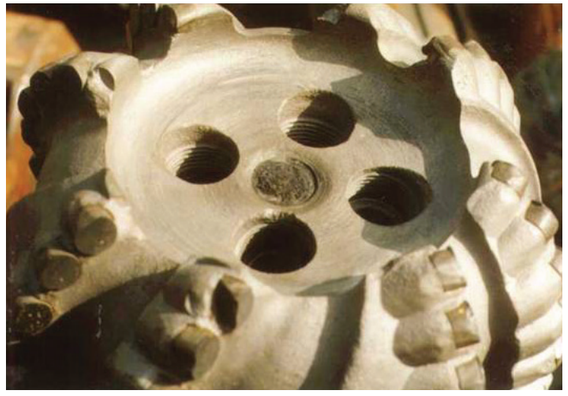
Remedy
Improved drilling practices; managing vibration.

(BU) Balled Bit

Obstruction of the junk slot by the cuttings.

Cause
Hydraulics; drilling practices; mud properties; reactive formations.

Remedy
Optimized hydraulics and mud properties; follow best practices for returning to bottom.



(CR) Cored

The loss of effective cutting structure and substantial damage to the matrix originating from the center of the bit. Results in bottomhole pattern forming a peak.

Cause
Drilling practices; lost or broken cutter; high WOB; drillout damage; highly abrasive formation; vibration; off-center rotation.

Remedy
Carefully establish new bottomhole pattern; vibration management; best drilling practice.

(CT) Chipped Teeth/Cutters

Minor chipping of the diamond table along the cutter edge.

Cause
Vibration; formation change.

Remedy
Drilling parameter optimization.

(ER) Erosion

Loss of carbide substrate behind the diamond table or loss of bit-body material from fluid action.

Cause
High flow rate; high HSI; high solids content;abrasive sand.

Remedy
Hydraulics optimization; mud properties.

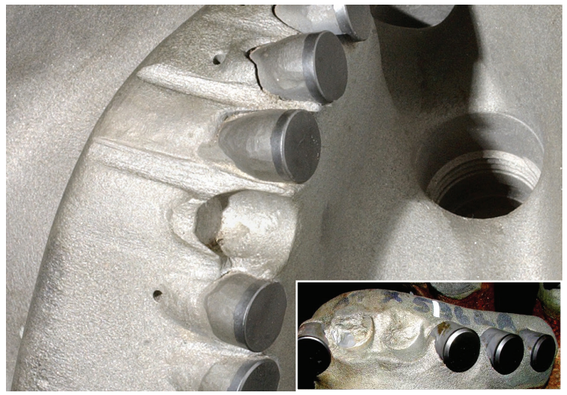
(LN) Lost Nozzle

One or more nozzles missing from the bit.

Cause
Poor nozzle installation.

Remedy
Use proper nozzle; proper installation techniques, ensuring a good O-ring in each nozzle boss or cavity.

Dull characteristics



(LT) Lost Teeth/Cutters

Complete loss of one or more cutters, resulting in an empty pocket.

Cause
Erosion; vibration; junk damage.

Remedy
Operating parameters, vibration management.

(NO) No Major/Other Dull Characteristics

No major dull characteristics.

(RO) Ringout

The loss of effective cutting structure and substantial damage to the matrix, originating outside the center of the bit usually in the shoulder area. Bottomhole pattern forms a ring.

Cause
Drilling practices; lost or broken cutter; drillout damage; highly abrasive formation; vibration.

Remedy
Carefully establish new bottomhole pattern; vibration management; best drilling practices.

(WT) Worn Teeth/Cutters

Less cutter projection as a result of even wear.

Cause
Normal drilling in a stable mode. Wear in abrasive formations.

Remedy
This is a desirable feature when performance is optimized.

Wear Scars (Tiger Stripes)

Wear on the bit body as a result of properly functioning depth of cut control (DOCC) technology.

Cause
The DOCC is designed to let the bit body contact and rub the formation in order to limit torque fluctuations.

Remedy
Evidence of the wear scars indicates the DOCC technology is working. No remedies necessary.

Note: Wear scars are not an IADC dull condition description.

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