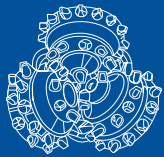


# IADC DULL GRADING SYSTEM FOR ROLLER BITS



# Standardized Dull Bit Grading System

Today's competitive oilfield mandates drilling wells as efficiently and economically as possible. Few oilmen will argue, the people most successful at making hole are those with good iron, experienced crews and the best drilling information.

One tool for obtaining timely and accurate drilling information is grading the dull rock bit. When the dull bit comes out of the hole, a study of its cutting structure and bearing condition can tell a very important story. An accurate dull grade gives a good picture of how the hole was drilled. Did the bit perform to its full potential? If not, what changes do we need to make before we go back into the hole again?

Careful inspection of the dull cutting structure and bearings can give us a good handle on the bit's dull

characteristics which can affect our next bit selection, break-in procedures and operating practices. Grading a dull bit, and evaluating those findings is a simple operation that can increase our drilling efficiency while lowering drilling costs.

The industry has developed a dull bit grading method and symbols that simplify this important operation. The dull grading symbols indicated here can be used to grade all types of bits, including:

- Journal bearing bits, carbide and steel tooth*
- Sealed ball and roller bits of both types*
- Non-sealed bearing bits*
- Natural diamond bits*
- Polycrystalline diamond bits*
- Thermally stable polycrystalline diamond bits*

## SYSTEM STRUCTURE

The dull grading method described herein follows the IADC Grading System. Eight columns of information are used for reporting dull bit conditions on bit records.

T		B		G		REMARKS	
CUTTING STRUCTURE				B	G	REMARKS	
Inner Rows (1)	Outer Rows (o)	Dull Char. (D)	Location (L)	Brng. Seal (B)	Gauge 1/16 (G)	Other Dull (O)	Reason Pulled (R)

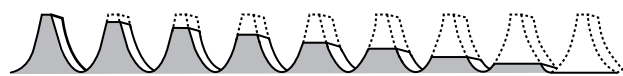
1. Column 1 (I-Inner) is used to report the condition of the cutting elements not touching the wall of the hole (Inner). The change from inner 2/3 of the cutting structure was made to reduce variations in grading and increase understanding of the system.

2. Column 2 (O-Outer) is used to report the condition of the cutting elements that touch the wall of the hole (Outer). In the previous version, this was the outer 1/3 of the cutting structure. This change reflects the importance of gauge and heel condition to good bit performance.

In columns 1 and 2 a linear scale from 0-8 is used to describe the condition of the cutting structure as follows.

**STEEL TOOTH BITS** — A measure of lost tooth height

- 0 - no loss of tooth height
- 8 - total loss of tooth height



**INSERT BITS** — A measure of combined cutting structure reduction due to lost, worn and/or broken inserts/teeth.

- 0 - no loss of cutting structure
- 8 - total loss of cutting structure

*Example:* A bit missing half of the inserts on the inner rows of the bit due to loss or breakage with the remaining teeth on the inner rows having a 50% reduction in height due to wear, should be graded a 6 in column 1. If the inserts on the outer rows of the bit were all intact but were reduced by wear to half of their original height, the proper grade for column 2 would be 4.

3. Column 3 (D-Dull Characteristic - Cutting Structure) uses a two-letter code to indicate the major dull characteristic of the cutting structure. Table 1 lists the two-letter codes for the dull characteristics to be used in this column.

**TABLE 1 – DULL CHARACTERISTICS**

*BC — Broken Cone	LN — Lost Nozzle
BF — Bond Failure	LT — Lost Teeth / Cutters
BT — Broken Teeth / Cutters	OC — Off-Center Wear
BU — Balled Up Bit	PB — Pinched Bit
*CC — Cracked Cone	PN — Plugged Nozzle /
*CD — Cone Dragged	Flow Passage
CI — Cone Interference	RG — Rounded Gage
CR — Cored	RO — Ring Out
CT — Chipped Teeth / Cutters	SD — Shirttail Damage
ER — Erosion	SS — Self-Sharpening Wear
FC — Flat Crested Wear	TR — Tracking
HC — Heat Checking	WO — Washed Out Bit
JD — Junk Damage	WT — Worn Teeth / Cutters
*LC — Lost Cone	NO — No Dull Characteristic

\*Show Cone # or #'s under location 4.

4. Column 4 (L-Location) uses a letter or number code to indicate the location on the face of the bit where the cutting structure dulling characteristic occurs. Table 2 lists the codes to be used for describing location on roller cone bits.

*NOTE:* "G" (gauge row) replaces "H" for this version.

**TABLE 2 — LOCATION (ROLLER CONE BITS)**

		Cone #
N	— Nose Row	1
M	— Middle Row	1
G	— Gauge Row	2
A	— All Rows	3

Location is defined as follows:

Gauge - Those cutting elements which touch the hole wall.

Nose - The centermost cutting element(s) of the bit.

Middle - Cutting elements between the nose and the gauge.

All - All Rows

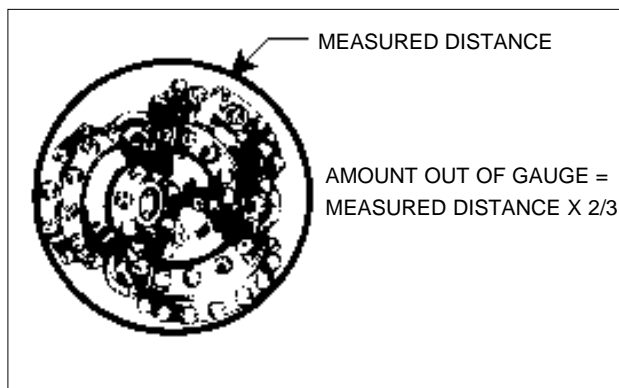
Cone numbers are identified as follows:

The number one cone contains the centermost cutting element.

Cones two and three follow in a clockwise orientation as viewed looking down at the cutting structure with the bit sitting on the pin.

5. Column 5 (B-Bearing/Seals) uses a letter or a number code, depending on bearing types, to indicate bearing condition of roller cone bits. For non-sealed bearing roller cone bits, a linear scale from 0-8 is used to indicate the amount of bearing life that has been used. A zero (0) indicates that no bearing life has been used (a new bearing) and an 8 indicates that all of the bearing life has been used (locked or lost). For sealed bearing (journal or roller) bits, a letter code is used to indicate the condition of the seal. An "E" indicates an effective seal, an "F" indicates a failed seal(s), and an "N" indicating "not able to grade" has been added to allow reporting when seal/bearing condition cannot be determined.

6. Column 6 (G-Gauge) is used to report on the gauge of the bit. The letter "I" (IN) indicates no gauge reduction. If the bit does have a reduction in gauge it is to be recorded in 1/16th of an inch. The "Two Third's Rule" is correct for three-cone bits.



"TWO THIRDS RULE"

The Two Thirds Rule, as used for three-cone bits, requires that the gauge ring be pulled so that it contacts two of the cones at their outermost points. Then the distance between the outermost point of the third cone and the gauge ring is multiplied by 2/3's and rounded to the nearest 1/16th of an inch to give the correct diameter reduction.

7. Column 7 (O-Other Dull Characteristics) is used to report any dulling characteristic of the bit, in addition to the cutting structure dulling characteristic listed in column 3 (D). Note that this column is not restricted to only cutting structure dulling characteristics. Table 1 lists the two-letter codes to be used in this column.

8. Column 8 (R-Reason Pulled) is used to report the reason for terminating the bit run. Table 3 lists the two-letter or three-letter codes to be used in this column.

**TABLE 3 — REASON PULLED OR RUN TERMINATED**

BHA	— Change Bottom Hole Assembly
CM	— Condition Mud
CP	— Core Point
DMF	— Downhole Motor Failure
DP	— Drill Plug
DSF	— Drill String Failure
DST	— Drill Stem Testing
DTF	— Downhole Tool Failure
FM	— Formation Change
HP	— Hole Problems
HR	— Hours on Bit
LH	— Left in Hole
LOG	— Run Logs
PP	— Pump Pressure
PR	— Penetration Rate
RIG	— Rig Repair
TD	— Total Depth / Casing Depth
TQ	— Torque
TW	— Twist Off
WC	— Weather Conditions

The following is a discussion of the dulling characteristics common to roller cone bits:

### **BROKEN CONE (BC)**

The broken cone in this photo was caused by hydrogen sulfide embrittlement. A cone also may break when the bit hits a ledge during a trip or connection, or there is cone interference caused by the cones running on each other after a bearing failure. Notice the two flat axial breaks on this particular bit. The circumferential break is the cup/cone tear break. Generally, the "BT" on Cone One and Cone Two is caused by junk left on the bottom by Cone Three. The crest of the broken inserts indicates the insert break was caused by the inserts impacting the cone piece during drilling.



**BROKEN CONE (BC)**

### **BROKEN TEETH (BT)**

This photo is an example of multiple tooth breakage. The sharp edges to the junk dent marks in the cone shell indicates this chippage, or breakage, occurred near the end of the bit run. Note also that the heel inserts and nose inserts have remained in the best condition.

In some formations, broken teeth, like chipped teeth, can be a normal wear characteristic of tungsten carbide insert (TCI) bits and does not necessarily indicate problems in bit application or operating practices. Broken teeth, however, are not considered a normal wearing condition for steel tooth bits. For those, it may indicate either improper bit application or operating practices.

In TCI bits, this dull feature frequently occurs when the compressive strength of the rock exceeds the compressive strength of the cutting structure. If, however, the bit run was of unusually short duration, broken teeth could indicate excessive weight and/or rpm, improper bit application and/or the need for a shock sub. Excessive weight for the particular application is evident by broken teeth predominately on the inner and middle rows. Excessive rpm for the particular application is indicated by breaks predominately on the gauge row.

Teeth also can break when the bit is run on junk, hits a ledge or suddenly strikes the bottom, or the bit has been improperly broken in, which is indicated by a major change in the bottomhole pattern. Drilling a formation that is too hard for the type of bit being used also can break teeth.



**BROKEN TEETH (BT)**





BALLED BIT (BU)

### **BALLED BIT (BU)**

A balled-up bit will show tooth wear. This is caused by a cone, or cones, being unable to turn because of formation being packed between the cones. It erroneously may appear a bearing has locked up. After cleaning the cutting structure of this particular bit, it was discovered the bearings were in good condition, which often is the case with a balled-up bit.

Balling may occur because of inadequate hydraulic cleaning of the hole, when the bit is forced into formation cutting with the pump not running, or by drilling a sticky formation.



CRACKED CONE (CC)

### **CRACKED CONE (CC)**

This photo shows a circumferentially cracked cone. This crack was caused by cone shell wear, which reduced the cone shell thickness over the cone retention groove. The heat generated by the formation wear during off-center running is responsible for this particular crack. From an operational standpoint, a cone may crack when junk is left on the bottom, the bit hits a ledge or bottom, or the drill string is dropped. Cones can also crack by hydrogen sulfide embrittlement, cone shell erosion, or overheating.



CONE DRAGGED (CD)

### **CONE DRAGGED (CD)**

This dull feature means one or more of the cones did not turn during part of the bit run. This is indicated by one or more flat wear spots. Usually, a dragged cone is caused by bearing failure on one or more of the cones, junk lodging between the cones, a pinched bit that causes cone interference, or a balled-up bit.



CONE INTERFERENCE (CI)

### **CONE INTERFERENCE (CI)**

On this bit, notice the "BT,M 3" breakage is irregular, indicating the Number One Cone shell and inserts impacted on another. The "WT,M 1" is a good example of insert wear against the adjacent cone shell material, as opposed to wear against the formation. Cone interference, which can lead to cone grooving and broken teeth, is often mistaken for formation damage. Broken teeth caused by cone interference does not indicate improper bit selection.

Some causes of cone interference are a pinched bit, reaming an undergauge hole with excessive weight on bit (WOB), or bearing failure in one or more cones.

### **CORED BIT (CR)**

The centermost cutters of this bit were damaged by a rock core that was left in the hole by the preceding bit. This is merely one way in which a bit can core.

A bit often cores when the nose part of one or more cones is broken, or when the abrasiveness of the formation exceeds the wear resistance of the center cutters. Improperly breaking in a new bit after a major change in the bottom hole pattern also can result in coring. A bit will also core when cutters are lost because of cone shell erosion, or when junk left in the hole breaks the center cutters.

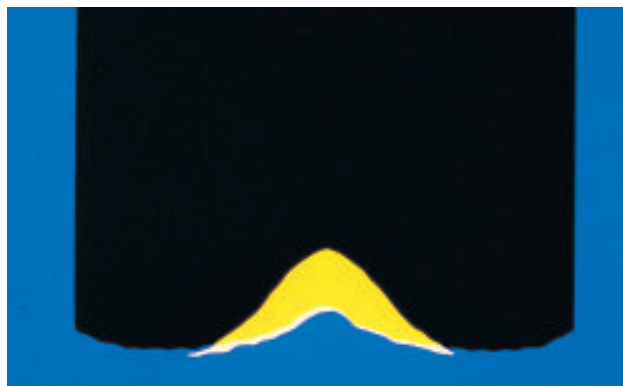


CORED BIT (CR)

### **BOTTOM HOLE PATTERN OF CORED/ NON-CORED BIT**

This photo compares the bottom hole pattern of a bit that has been cored and one that is running normally.

The yellow portion shows the formation mound left on the bottom by a previously run bit that was cored. In number one or two rock, and with proper care, the mound can be removed and drilling proceed without coring the next bit. In the harder number's seven, eight or nine rock, it is recommended the core first be cleaned up and 5-10 ft of new hole can be drilled. Afterwards, it is wise to trip and examine the bit to determine if another cleaning is called for.



BOTTOM HOLE PATTERN OF CORED/  
NON-CORED BIT

### **CHIPPED TEETH (CT)**

This photo shows two examples of how teeth can chip. Note the chipped insert on the upper left middle row, adjacent to the heel, or gauge, row. This insert was sheared by impact from something on the bottom of the hole. The two inserts to the right in the same row each have a single break with a ridge in the center and a small one to the side.

On TCI bits, chipped teeth often become broken teeth. A tooth is considered to only be chipped if a substantial part remains above the cone shell. Possible causes of chipped teeth are impact loading caused by rough running and/or slight cone interference. Usually, chipped teeth are not indicative of any problems in bit applications or operating parameters.



CHIPPED TEETH (CT)





EROSION (ER)



FLAT CRESTED WEAR (FC)



HEAT AFFECTED SEAL



HEAT CHECKING (HC)

### **EROSION (ER)**

The erosion indicated in this photo suggests abrasive cuttings in the mud traveled at a high rate from right to left. When encountering an insert, the eddy effect caused the cuttings to remove the cone shell on the right side of the inserts.

On TCI bits, the loss of cone shell material can lead to a loss of inserts, because the support and grip of the cone shell material was reduced. Erosion also can indicate a hydraulic-related problem. Abrasive cuttings can erode the cone shell because of inadequate hydraulics. On the other hand, excessive hydraulics can lead to high-velocity fluid erosion. An abrasive formation contacting the cone shell between the cutters also can lead to erosion. This is usually caused by tracking, off center wear, or excessive WOB.

### **FLAT CRESTED WEAR (FC)**

This characteristic generally reduces the rate of penetration toward the end of the run and ends many steel tooth runs. As shown here, flat crested wear is an even reduction in height across the entire face of the cutters. Flat crested wear is dependent on many factors, including formation, hardfacing and operating parameters. This characteristic often is caused when weight is decreased and rpm is increased to control deviation.

### **HEAT AFFECTED SEAL**

A bearing may fail because of a heat affected seal (would be denoted on form as SF). Thermal degradation of a seal is a time and temperature reaction and can be caused by modest temperature over long runs, or by high temperature over short runs. The damage to the bit shown here was caused when, after making a connection, drilling resumed without starting the mud pump.

### **HEAT CHECKING (HC)**

Heat checking occurs when a cutter overheats by being dragged on the formation and is later cooled by the drilling fluid over many cycles. Along with dragging the cutters, heat checking also can occur when reaming a slightly undergauge hole at high rpm. Heat checking on this particular bit was caused by reaming with a motor, which is considered a bad drilling practice. Note here that one leg of the bit was removed so the bearing could be examined.

### **JUNK DAMAGE (JD)**

This can be determined by marks on any part of the bit. The deep groove in the shirttail of this bit is believed to have been caused by junk from the bit itself. The heavy cone shell erosion around the heel inserts makes it easy to understand why an entire insert would be dropped. Note the circumferential scratches, which came from sharp formation damage. It sometimes is necessary to clear the junk from the hole before proceeding.

Common sources of junk, and thereby junk damage are: junk dropped in the hole from the surface, junk from the drill string, such as reamer pins, stabilizer blades, etc.; junk from a previous bit run, and junk from the bit itself.



JUNK DAMAGE (JD)

### **LOST CONE (LC)**

Cones can be lost in a variety of ways. With few exceptions, the dropped cone must be cleared from the hole before drilling can resume. Cones can be lost by the bit striking a ledge or the bottom during a trip, or connection. A dropped drill string, bearing failure, or hydrogen sulfide embrittlement also can cause a cone to be lost.

### **LOST NOZZLE (LN)**

This is an important other dulling characteristic that can help explain a bit run. A lost nozzle causes a pressure decrease that requires the bit be pulled from the hole. A lost nozzle also is a source of junk in the hole.

Some possible causes of lost nozzles are improper installation, improper nozzle and/or nozzle design, or mechanical or erosion damage to the nozzle and/or nozzle retaining system. On the bit shown here, the washing action indicates a nozzle without a good O-ring. It was later determined the lack of sealing was caused by installing another manufacturer's nail-retained nozzle in a Hughes Christensen assembly. This meant the Hughes Christensen O-ring was left unsealed by the nail groove of the incompatible nozzle.



LOST CONE (LC)



LOST NOZZLE (LN)





LOST TEETH (LT)

### LOST TEETH (LT)

On this bit, the middle row of the Number One cone is a good example of cone cracking running in a circumferential manner from the bottom of the insert hole to the bottom of the adjacent insert hole. This has loosened the hold of the cone on the insert, resulting in the loss of some inserts. It is important to note that the nose insert of the Number One cone is lost because of cone shell erosion. On TCI bits, this characteristic results in entire inserts being left in the hole, thereby causing potential junk damage.

Lost teeth occasionally are preceded by rotated inserts. Along with cone shell erosion, teeth can be lost by a crack in the cone that loosens the grip on the inserts and by hydrogen sulfide embrittlement cracks.

### OFF CENTER WEAR (OC)

This occurs when the geometric center of the bit and the geometric center of the hole do not coincide. The result is an oversized hole.

Off center wear is identified either by wear on the cone shells between the rows of cutters, more gauge wear on one cone, or by a less than expected penetration rate. Off center wear can reduce ROP more so than a tracking bit. On this particular bit, the cone on the right was cutting an oversized hole, while the cone to the left had little, or no engagement with the wall of the hole. Since the wear is between the rows of inserts, this indicates the bit was drilling an oversized hole.

Some causes of off center wear are a change in the formation from brittle to plastic, inadequate stabilization in deviated hole, inadequate weight for the formation, improper bit type, and when the hydrostatic pressure significantly exceeds the formation pressure. Off center wear can be eliminated by changing bit types, thereby changing the bottom hole pattern.



OFF CENTER WEAR (OC)

### PINCHED BIT (PB)

Bits become pinched when they are mechanically forced to a less than original gauge. The bit shown here, for example, was forced into an undersized BOP stack. Note the broken heel inserts. Generally, the ridge from broken inserts is circumferential, while the ridge in insert breakage normally is perpendicular to the force causing the breakage. Several of these heel inserts have circumferential crests on the broken heel inserts, which indicates the undersized BOP broke the heel inserts.

Other causes of pinched bits are forcing the bit into an undergaged hole, forcing a rolling cone bit into a section of hole drilled by a fixed cutter bit, forcing a bit through casing that does not drift to the bit size, or pinching a bit in the bit breaker. Pinched bits can lead to broken teeth, chipped teeth, cone interference,



PINCHED BIT (PB)

### **PLUGGED NOZZLE (PN)**

While this dulling condition does not describe the cutting structure, it nonetheless can be useful in providing information about a bit run. A plugged nozzle can result in reduced hydraulics, or force a trip out of the hole because of excessive pump pressure. Jamming the bit into fill with the pump off can plug a nozzle. Plugging can occur when during a connection solid material going up the drill string and through the bit becomes lodged in a nozzle when circulation is resumed. Conversely, solid material being pumped down the drill string also can lodge in a nozzle.



PLUGGED NOZZLE (PN)

### **ROUNDED GAUGE (RG)**

This dulling condition describes a bit that has experienced gauge wear in a rounded manner, but has yet to wear out of normal gauge. The heel inserts may be less than gauge, but the cone backfaces are still within nominal diameter. On this particular bit, the lack of shirrtail and hardfacing wear along with the remaining bevels on the gauge inserts, suggest it was still drilling a nominal gauge hole. The gauge of a bit can become rounded when drilling an abrasive formation with excessive rpm, or reaming an under gauge hole.



ROUNDED GAUGE (RG)

### **SHIRTTAIL DAMAGE (SD)**

Damage to the shirrtail may be different from junk damage and is not considered a cutting structure dulling characteristic. Shirrtail wear can lead to seal failures. Junk left in the hole, reaming an under-gauge hole in faulted or broken formations, or a pinched bit that makes the shirrtail the outermost part of the bit, are some of the causes of shirrtail damage.



SHIRTTAIL DAMAGE (SD)

### **SELF-SHARPENING WEAR (SS)**

Since self-sharpening helps maintain better penetration rates throughout the run, this dulling characteristic often indicates proper bit selection and operating parameters. Both TCI and steel tooth bits may wear in a self-sharpening manner. As shown here, the cutters wear in such a manner as to retain some cutting edge.



SELD-SHARPENING WEAR (SS)





TRACKING (TR)

### **TRACKING (TR)**

As shown here, the middle rows that tracked have turned the cones at an improper speed. The flat crested wear on the heel and inner rows also indicate improper speed. Another tracking indicator is the scooped wear between sharp crested teeth in a single row.

A tracking bit will drill a nominal gauge hole with all three cones reaching gauge. Tracking occurs when the teeth mesh like gears into the bottom of the hole. The cutter wear on a tracking bit will be on the leading and trailing flanks. The cone shell wear will be between the cutters in a row.

Tracking sometimes can be prevented by using a softer formation bit, or by reducing, if possible, the hydrostatic pressure. Tracking can be caused by changes in the formation from brittle to plastic, or when hydrostatic pressure significantly exceeds the formation pressure.



WELD WASH OUT (WO)

### **WELD WASH OUT (WO)**

Washout can occur at any time during a bit run. If the bit weld is porous, or not closed, the bit will start to wash out as soon as circulation begins. Often, the welds are closed, but will crack during the bit run because of impact with the bottom, or with ledges on connections.

When a crack occurs and circulation starts through the crack, the wash-out is established very quickly. Weld wash-out caused by drill string harmonics happens after the bit is in the hole long enough to indicate the weld was sealed during bit assembly. After Hughes Christensen installed triads during bit assembly, the frequency of weld washouts caused by drill string harmonics was reduced greatly.



WORN SEAL (Denoted as SF)

### **WORN SEAL (DENOTED AS SF)**

Under Seals/Bearings, one possible cause of bearing failure is a worn seal. In this photo, the seal is worn on the I.D. of the mud side. This particular wear was caused by mud solids wearing away the seal material.



## WORN TEETH (WT)

This is a normal dulling characteristic for both TCI and steel tooth bits. When “WT” is noted for steel tooth bits, it usually is appropriate to note either self-sharpening (SS) or flat-crested wear (FC).



WORN TEETH (WT)

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## APPLYING GRADING SYSTEMS TO DULLS

The best way to fully understand the benefits inherent in the dull grading system is to see its application on roller cone bits. Therefore, following are the graded dull condition of three bits.

It is important to remember that in some

instances there may be more than one “correct” dull grading for each bit. This can occur if two grades should disagree on the primary cutting structure dulling characteristic or on what the other dulling characteristic should be.

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## GRADED DULL NO. 1

*This first bit was graded 7, 1, BT, M, E, I, WT, PR.*

The bit looks to have been dulled by encountering a harder formation than the bit was designed for. This is indicated by the heavy tooth breakage on the inner rows, and by the fact the bit was pulled for penetration rate. The reduced penetration rate was caused by tooth breakage occurring when the bit encountered the hard formation. Excessive weight on bit also could cause the dull to have this appearance.

The bit application was proper if the run was of reasonable duration, there was no evidence of “other” dulling characteristics, the seals were effective and the bit was pulled in gauge. If, however, the bit had a shorter than expected run, the application probably was improper. The bit may have been too soft for the formation, or it may have been run under excessive weight.



GRADED DULL NO. 1 (7, 1, BT, M, E, I, WT, PR)



GRADED DULL NO. 2 (5, 8, WT, A, 3, 2, FC, HRS)

### **GRADED DULL NO. 2**

*This bit was graded 5,8,WT,A,3,2,FC,HRS.*

This dull grade indicates proper bit selection and application. There is not a great deal more tooth wear (WT) on the outer cutters than on the inner cutters, which suggests proper rpm and weight on bit. Worn teeth is a normal dull characteristic in the harder tungsten carbide insert bits, as opposed to chipped or broken teeth, both of which could indicate excessive rpm or weight.

When pulled, the bit was still drilling well as indicated by listing HRS as reason pulled. The bit, however, was slightly under gauge (2/16") at this point and may well have rapidly lost more gauge if left in the hole. This supports the decision to pull the bit based on hours.

A bearing condition "3" on the air bearings suggests adequate bearing life still remaining. Since there are no harder bits available and the dull grade indicates a softer bit would not be appropriate, this seems to have been a proper bit application.



GRADED DULL NO. 3 (0, 0, NO, A, E, I, LN, PP)

### **GRADED DULL NO. 3**

*The third dull was graded 0,0,NO,A,E,I,LN,PP.*

Since there is no evidence of any cutting structure dulling, the 0,0,NO,A is used to describe the cutting structure. If this bit had been run for an extended time before losing the nozzle, this dull grading would indicate a softer bit - possibly a steel tooth - might be better suited to drill this interval. If the run was very short, it is probably the nozzle was not the proper one, or it was improperly installed. If this was the case, no other information concerning the proper or improper bit application can be determined.

# IADC DULL GRADING SYSTEM

CUTTING STRUCTURE				BEARINGS/ SEALS	GAUGE	OTHER DULL CHAR.	REASON PULLED
INNER	OUTER	DULL CHAR.	LOCATION				
I	O	D	L	B	G	O	R

## I — INNER CUTTING STRUCTURE (All inner rows)

### O — OUTER CUTTING STRUCTURE (Gauge row only)

In columns 1 and 2 a linear scale from 0 to 8 is used to describe the condition of the cutting structure according to the following:

#### STEEL TOOTH BITS

A measure of lost tooth height due to abrasion and / or damage.

0 — NO LOSS OF TOOTH HEIGHT  
8 — TOTAL LOSS OF TOOTH HEIGHT

#### INSERT BITS

A measure of total cutting structure reduction due to lost, worn and / or broken inserts.

0 — NO LOST, WORN AND / OR BROKEN INSERTS  
8 — ALL INSERTS LOST, WORN AND / OR BROKEN

#### FIXED CUTTER BITS

A measure of lost, worn and / or broken cutting structure

0 — NO LOST, WORN AND / OR BROKEN CUTTING STRUCTURE  
8 — ALL OF CUTTING STRUCTURE LOST, WORN AND / OR BROKEN

## D — DULL CHARACTERISTICS

(Use only cutting structure related codes)

*BC — Broken Cone	LT — Lost Teeth / Cutters
BF — Bond Failure	OC — Off-Center Wear
BT — Broken Teeth / Cutters	PB — Pinched Bit
BU — Balled Up Bit	PN — Plugged Nozzle / Flow Passage
*CC — Cracked Cone	RG — Rounded Gauge
*CD — Cone Dragged	RO — Ring Out
CI — Cone Interference	SD — Shirttail Damage
CR — Cored	SS — Self-Sharpening Wear
CT — Chipped Teeth / Cutters	TR — Tracking
ER — Erosion	WO — Washed Out Bit
FC — Flat Crested Wear	WT — Worn Teeth / Cutters
HC — Heat Checking	NO — No Dull Characteristic
JD — Junk Damage	
*LC — Lost Cone	
LN — Lost Nozzle	

\*Show cone # or #'s under location 4.

## L — LOCATION

### ROLLER CONE

N — Nose Row	Cone #
M — Middle Row	1
G — Gauge Row	2
A — All Rows	3

### FIXED CUTTER

C — Cone
N — Nose
T — Taper
S — Shoulder
G — Gauge
A — All Areas

## B — BEARING SEALS

### NON SEALED BEARINGS

A linear scale estimating bearing life used. (0 - No life used, 8 - All life used, ie. no bearing life remaining.)

### SEALED BEARINGS

E — seals effective
F — seals failed
N — not able to grade
X — fixed cutter bit (bearingless)

## G — GAUGE

1	—	in gauge
1/16	—	1/16" out of gauge
2/16	—	1/8" out of gauge
4/16	—	1/4" out of gauge

## O — OTHER DULL CHARACTERISTIC

Refer to column 3 codes



## R — REASON PULLED OR RUN TERMINATED

BHA — Change Bottom Hole Assembly	LIH — Left in Hole
CM — Condition Mud	LOG — Run Logs
DMF — Downhole Motor Failure	PP — Pump Pressure
DP — Drill Plug	RIG — Rig Repair
DSF — Drill String Failure	TD — Total Depth / Casing Depth
DST — Drill Stem Testing	TQ — Torque
DTF — Downhole Tool Failure	TW — Twist Off
FM — Formation Change	WC — Weather Conditions
HP — Hole Problems	
HR — Hours on Bit	





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