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REPORT ON THE TESTING OF THE NO-FLOW PUSH BIT

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Abstract: Testing was carried out in the Engineering Testing Laboratory, 305 Building- 300 Area, during June, July and August of 1996. This testing was to develop and proof test a new sampler insert which would prevent purge gas from flowing through a push-mode core drilling bit - and subsequently prevent rotation of the Rotary Mode Core Sampling System (RMCSS) when the push bit was used.

The testing involved push-mode sampling with both a new push mode insert and a rotary insert in a push mode bit into two simulants. A total of sixty final test runs showed that the inserts are successful in preventing purge flow and hence in preventing rotation with a push-mode bit installed.

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**REPORT ON THE TESTING
OF
THE "NO-FLOW" PUSH BIT**

WHC-SD-WM-TRP-264
REV. 0

September 17, 1996

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TESTING OF THE NO-FLOW PUSH BIT

1.0 INTRODUCTION

The Westinghouse Engineering Testing Laboratory, with funding from the Westinghouse Characterization Equipment Design Group, did testing on the "No-Flow" push-mode sampling bit and rotary and push-mode sampler inserts. This testing followed Test Plan WHC-SD-WM-TP-444¹ and was carried out during June, July and August of 1996. Testing was done in the 305 Building of the 300 Area on the Hanford Reservation near Richland, WA.

A push mode bit and both a rotary and push mode sampler insert were tested to verify that purge flow rates could be held below 15 SCFM when a Universal Sampler was used in a push mode bit. Since the push mode bit is not designed to rotate when sampling, and could possibly cause an ignition of flammable gasses found in some waste tanks, a method to prevent rotation was needed.

The Rotary Mode Core Sampling System will not allow rotation unless 30 SCFM of purge gas is flowing through the drill string. The sampler inserts were redesigned to allow less than half of this minimum purge flow whenever the push bit is in use. This report documents the results from testing of the push and rotary mode sampler inserts with a push mode bit in two different simulants.

2.0 TEST METHOD AND TEST EQUIPMENT

2.1 TEST ITEMS

Table 1 below lists the items tested.

Table 1 - Equipment Items Tested

ITEM DESCRIPTION	PART NUMBER
"No-Flow" push-mode bit	Longyear p/n 1000VD/1
Rotary-mode sampler insert	TBD
Push-mode sampler insert	TBD

The push bit incorporates a 60° cone with a one inch diameter hole through the center. Like the Rotary bit, the push bit screws onto a standard core barrel and is machined internally to mate with a Universal Sampler. The sampler has an end piece, called an insert, which makes contact with the drill bit. This newly designed insert has a sharp "knife-edge" lip, which, when in contact with the angled surface inside a rotary or push bit, provides an almost airtight seal. Drawings of the push bit, push and rotary insert, and their sealing configurations are shown below in Figures 1 through 6. These items are prototypes, and except the push bit, do not yet have Hanford drawing or part numbers.

NO-FLOW PUSH BIT
(AS TESTED)

TOLERANCE
.XX $\pm .03$
.XXX $\pm .005$

Figure 1 - "No Flow" Push Bit

Figure 2 - Push Insert

Figure 3 - Rotary Insert

Figure 6 - Push and Rotary Inserts mounted in Push and Rotary Bits

2.2 TEST METHOD

Approximately 15 feet of standard carbon steel drill string was attached to a Longyear Model 34 drill truck with the core barrel mounted to the lower end of the drill string and a push bit screwed into the end of the core barrel. A Remote Latching Unit (RLU) with 34 pounds of weight on it was used to lower, set, and release the sampler inside the core barrel. As the sampler contacted the inner surface of the push bit, the RLU allowed the quadrilatch fingers on the sampler to expand and insert themselves into the serrated edges on the inner diameter of the core barrel. Pressurized air at 90 psig was fed into the drill string. With the system pressurized, the core barrel/sampler was pushed down into a fifty-five-gallon drum of simulant at a rate of 10 inches per minute. The drum of simulant rested on a floor scale which measured the downward force. This measurement was sent to a remote indicator for the drill truck operator to monitor.

Fifteen tests, each, using both inserts, were run in two different simulants - for a total of 60 tests. The first simulant was common construction sand with a small amount of water (approximately 5% by volume) added, to aid in packing of the sand. This simulant provided an abrasive and hard-to-penetrate media with an average particle size of 0.030 to 0.040-inch diameter. The sand provided a media which could pack up sufficiently to provide the high (2000 lbf) down forces, and yet was still fluid enough to flow up to the sampler valve. This enabled the testing to show that sampler would not compress enough under load to cause a seal failure. The downward force was controlled while pushing into this simulant and was allowed to reach two thousand lbf before ending the test. After a test run, the core barrel was lifted up out of the simulant, the pressurized air was shut off, and the sampler was removed from the core barrel, inspected and cleaned. A new sampler was again loaded into the core barrel for a repeat test.

The other simulant was a 47.9% Kaolin clay, 39.1% water and 13% Sulfur K-Mag mixture. This simulant would flow up into the sampler under a vacuum but would "slump" only slightly (ie. , it was "sticky"). The small K-Mag particles, 0.125 inch diameters, were intended to create an obstruction between the sealing surfaces, if possible. Depth of penetration was limited to approximately nine inches. This simulant was used to demonstrate how effectively the knife seal would perform after the contact surfaces were coated with a sticky simulant.

2.3 TEST EQUIPMENT

2.3.1 CORE DRILLING MACHINE

The drilling machine was a Longyear Model 34. This testing drill, in its basic form, is the same type of drill installed on the core sampling trucks for field operations. The drill provided the vertical displacement and 0 to 2000 lbf needed.

2.3.2 MEASURING EQUIPMENT

Table 2 below lists the different measuring equipment used by name, serial number, range, accuracy and calibration information.

Table 2 - Test Measuring Equipment

Item	Manufacturer	Serial Number	Range	Accuracy	Calibration
Purge Gas Rotameter Flowmeter	Fischer-Porter, Inc.	T-459	0-8.08 @ S.T.P. (14.7 psia, 70°F)	+/- 1 % Full Scale	Standards Lab # 750-28-13-004 Expires 7/18/97
Purge Gas Type K Thermocouple	Omega Engineering, Inc.	686	Type K -270 to 1370 °C	+/- 2.2°C	Two Point Ice Bath & Boiling Water Check
Purge Gas Bourdon Tube Pressure Gage	Marsh, Inc.	N/A	0 to 100 psig	+/-2% Full Scale	750-31-04-015 Expires 9/8/96
Platform Floor Scale-Load Cell	Toledo, Inc.	4387160- 4ww	0 to 5000 lbf	+/- 1 lbf	750-06-01-004 Expires 12/21/96
Vertical Position Indicator - String Potentiometer	Celeasco, Inc.	A0650553	0 to 36 inches	+/- 0.1 inches	Lab - Compared against Linear Scale

The flowmeter was calibrated to operate at standard temperature and pressure - 0 psia & 70°F (STP). Since testing had flows at 90 psia and varying measured temperatures, conversion from the indicated flow rate to a true flow rate was required. Bernoulli's equation is arranged to provide true flow rates:

$$F_t = F_i / [\text{SQRT}(14.7 * (460 + T) / ((P + 14.7) * 530))]]$$

Where:

F_i = Indicated Flow in (CFM)

F_t = True purge flow through bit (SCFM)

T = Temperature of purge gas (°F)

P = Pressure of purge gas (psig)

3.0 TEST RESULTS

Early scoping testing used a push bit with a rubber seal bonded to the inner diameter surface. The seal was constructed with multiple sealing edges or serrations designed to prevent purge gas from flowing past the sampler. This design proved unsuccessful during preliminary testing and the knife edge seal design as depicted in figures 1, 2 and 6 was tested instead.

Both the push and rotary inserts incorporate this knife-edge seal and likewise both the modified push and modified rotary drill bits, as seen in figure 6, will accommodate this type of seal. A total of sixty final proof tests were completed on the two inserts and push bit. Fifteen tests with each insert were run using the sand simulant for a total of thirty tests, and fifteen tests with each insert were run using the kaolinite sludge simulant for a total of thirty more. The final tested version of each insert/bit combination was able to effectively allow less than 10 SCFM purge flow from passing through the system. Results from the individual insert style testing are described below. A table listing each test is provided in Appendix A.

3.1 PUSH INSERT

The push insert proved successful in early tests. The highest purge flow recorded while pushing into kaolinite was 5.96 SCFM, with the average flow value at 3.75 SCFM.

While sampling into wet sand, downward forces on the sampler caused the sampler to lift up in the core barrel which separated the knife edge contact between the insert and bit that in turn caused a sudden increase in purge flow. This purge flow, although still below the 15 SCFM limit, was uncharacteristically high. It also blew the sand away from the face of the bit and limited the down force attainable to 700 lbf. The sampler valve had been kept closed while in sand up to this point (to speed up testing by not having to clean the sample tube) but the resultant forces placed on the sampler valve were found uncharacteristic of actual field sampling and the sampler valve was left open for the remaining tests.

This change allowed the remaining tests successfully to sample at an average purge flow rate of 2.92 SCFM. One test showed an increase in purge flow to 8.52 SCFM, but later inspection showed it was most likely caused by worn serrations on the core barrel tube.

3.2 ROTARY INSERT

Several design schemes were tested before a suitable rotary insert was developed. The difficulty with the rotary insert was the tendency for the purge gas to leak through the clearance space between the inner and outer bearing races. Several o-ring type seals were tried, included a standard Buna N O-Ring and a square cross section Teflon ring, among others, to block off this leak path. The rubber O-Ring sealed well but squeezed between the two races and prevented rotation of the insert. The Teflon ring allowed free movement of the insert, but required extremely close machine tolerances (1 to 2 mils) to hold a seal. Another solution which did not require a sealing ring was decided upon during testing.

During machining operations, certain dimensions can easily be held within very close tolerances while other dimensions are harder to hold without creating numerous rejects and subsequent expense. The location on the insert where the O-Ring seal could be positioned was a "hard-to-hold" machining tolerance, while another dimension, the inner and outer diameter of the outer and inner race, respectively, was not. Earlier versions of this insert assembly had an average clearance of 0.010 inches between the inner and outer race. By holding the clearance between the inner and outer race to +0.001 to +0.003 inches, the purge flow between the two was reduced dramatically. This "close tolerance" insert was successful in keeping the purge flow to well below 10 SCFM and was used for the remaining tests in both kaolinite clay and wet sand.

Six sets of rotary inserts were used. Each insert set had slightly differing clearances between races. By using each set, the testing was able to show that some variation in machining of parts (within acceptable tolerances) would not allow excessive purge flow. The dimensions for each insert set is given in Table 4 in Appendix A.

Except some sampler seating problems (caused by the core barrel quadrilatch serrations being worn out from previous testing), all fifteen tests into kaolinite and all fifteen tests into wet sand were successful. The average purge flow rate was 3.71 and 4.85 SCFM for the kaolinite and wet sand respectively. The maximum flow rate was 4.50 and 5.35 SCFM for the kaolinite and wet sand respectively.

4.0 CONCLUSIONS AND RECOMMENDATIONS

All test issues as outlined in the supporting test plan were addressed. The "No-Flow" rotary and push mode inserts successfully reduced purge flow to well within the 15 SCFM purge flow constraint given in the test plan. Reduction of purge flow is accomplished with either the rotary or push sampler placed into a push mode bit or with the push mode sampler placed into a rotary bit (with an o-ring seal installed).

5.0 DISPOSITION OF TEST ITEM

Testing is complete and the test items are available for further testing as needed.

6.0 REFERENCES

1. Kostelnik, A.J., "Testing of the No-Flow Push Bit", WHC-SD-WM-TP-444, Rev. 0, 7/16/96.

APPENDIX A - ROTARY AND PUSH INSERT TEST LISTING

The following table shows each test performed - listing both the scoping tests (to find the optimal design configuration) and the final prototype design tests. The final prototype testing is delineated by gray shading over the test # information.

Some tests involve inserts identified by the letters "A" through "F." These are rotary inserts and are identified separately because of slight variations in the dimensions of the inner and outer races. Table 4 lists the dimensions of these individual insert pieces.

Table 3 - Listing of Tests Performed

TEST #	SIMULANT TYPE	TEST PARTICULARS	INSERT TYPE	PURGE LEAK RATE (SCFM)	DATE
NOFLOW001	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	3.2	7/22/96
NOFLOW002	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	3.6	7/22/96
NOFLOW003	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	2.8	7/22/96
NOFLOW004	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	5.96	7/22/96
NOFLOW005	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	3.2	7/22/96
NOFLOW006	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	3.84	7/22/96
NOFLOW007	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	4.9	7/24/96
NOFLOW008	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	2.98	7/24/96
NOFLOW009	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	3.2	7/24/96
NOFLOW010	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	4.06	7/24/96
NOFLOW011	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	2.77	7/24/96
NOFLOW012	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	4.05	7/24/96

TEST #	SIMULANT TYPE	DESCRIPTION	INSERT TYPE	PURGE LEAK RATE (SCFM)	DATE
NOFLOW013	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	4.69	7/24/96
NOFLOW014	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	3.84	7/24/96
NOFLOW015	KAOLINITE	NO O-RING ON SAMPLER/KNIFE EDGE SEAL	PUSH	3.2	7/24/96
NOFLOW016	KAOLINITE	O-RING INSTALLED / SYSTEM LEAK CHECK (NO IMPROVEMENT)	PUSH	3.62	7/24/96
NOFLOW017	KAOLINITE	USING TEFLON RING	ROTARY	19.18	7/24/96
NOFLOW018	KAOLINITE	USING TEFLON RING	ROTARY	19+	7/24/96
NOFLOW019	SAND (DRY)	(SCOPING TEST) ONLY 250 LBF	PUSH	3.83	7/26/96
NOFLOW020	SAND (DRY)	(SCOPING TEST) 250+ LBF	PUSH	3.41	7/26/96
NOFLOW021	SAND (DRY)	(SCOPING TEST) 1800 LBF (NO PURGE)	PUSH	NONE	7/26/96
NOFLOW022	SAND (WET)	(SCOPING TEST) 2000 LBF	PUSH	4.9	7/26/96
NOFLOW023	SAND (WET)	(SCOPING TEST) 1000 LBF	PUSH	9.0	7/26/96
NOFLOW024	SAND (WET)	SCOPING - SYSTEM LEAK CHECK	PUSH	SYSTEM 3.2	7/26/96
NOFLOW025	SAND (WET)	2000 LBF @ 10" TRAVEL	PUSH	2.67 TO 7.03	7/26/96
NOFLOW026	SAND (WET)	2000 LBF @ 9" TRAVEL	PUSH	3.62 TO 9.38	7/26/96
NOFLOW027	SAND (WET)	2000 LBF @ 9.5" TRAVEL	PUSH	4.05 TO 9.59	7/26/96
NOFLOW028	SAND (WET)	2000 LBF @ ~ 9.5" TRAVEL	PUSH	4.88 TO 11.08	7/26/96
NOFLOW029	SAND (WET)	2000 LBF @ ~ 9" TRAVEL	PUSH	1.7 TO 8.5	7/26/96

TEST #	SIMULANT TYPE	DESCRIPTION	INSERT TYPE	PURGE LEAK RATE (SCFM)	DATE
NOFLOW030	SAND (WET)	2000 LBF @ ~ 9" TRAVEL	PUSH	1.7 TO 9.15	7/26/96
NOFLOW031	SAND (WET)	700 LBF (WORN SERRATIONS ON CORE BARREL -LOST SEAL)	PUSH	1.7 TO 15.34	7/26/96
NOFLOW032	SAND (WET)	SCOPING TEST TO FIND FORCE WHEN SEAL IS LOST	PUSH	1.71 TO 6.79	7/29/96
NOFLOW033	SAND (WET)	SCOPING TEST TO FIND FORCE WHEN SEAL IS LOST	PUSH	1.67 TO 16.05	7/29/96
NOFLOW034	SAND (WET)	SCOPING TEST TO FIND FORCE WHEN SEAL IS LOST	PUSH	3.64 TO 13.91	7/29/96
NOFLOW035	SAND (WET)	OPEN VALVE ON SAMPLER TUBE - 2000 LBF	PUSH	1.71	7/29/96
NOFLOW036	SAND (WET)	OPEN VALVE ON SAMPLER TUBE - 2000 LBF	PUSH	1.67 TO 4.92	7/29/96
NOFLOW037	SAND (WET)	OPEN VALVE - 2000 LBF @ 9"	PUSH	1.92	7/31/96
NOFLOW038	SAND (WET)	OPEN VALVE - 2000 LBF @ 9"	PUSH	2.34	7/31/96
NOFLOW039	SAND (WET)	OPEN VALVE - 2000 LBF @ 8.5"	PUSH	2.34	7/31/96
NOFLOW040	SAND (WET)	OPEN VALVE - 2000 LBF @ 8.5"	PUSH	1.92	7/31/96
NOFLOW041	SAND (WET)	OPEN VALVE - 2000 LBF @~ 9"	PUSH	2.56	7/31/96
NOFLOW042	SAND (WET)	OPEN VALVE - 2000 LBF @~ 9"	PUSH	2.98	7/31/96
NOFLOW043	SAND (WET)	OPEN VALVE - 2000 LBF @~ 9"	PUSH	2.77	7/31/96
NOFLOW044	SAND (WET)	OPEN VALVE - 2000 LBF @~ 9"	PUSH	2.13	7/31/96
NOFLOW045	SAND (WET)	OPEN VALVE - 2000 LBF @~ 9"	PUSH	1.21 TO 8.52	7/31/96
NOFLOW046	SAND (WET)	OPEN VALVE - 2000 LBF @~ 9"	PUSH	2.56	7/31/96
NOFLOW047	SAND (WET)	OPEN VALVE - 2000 LBF @~ 9"	PUSH	2.77	7/31/96
NOFLOW048	SAND (WET)	OPEN VALVE - 2000 LBF @~ 9"	PUSH	2.56	7/31/96
NOFLOW049	SAND (WET)	OPEN VALVE - 2000 LBF @~ 9"	PUSH	2.13	7/31/96

TEST #	SIMULANT TYPE	DESCRIPTION	INSERT TYPE	PURGE LEAK RATE (SCFM)	DATE
NOFLOW050	SAND (WET)	SCOPING - SAND INTERFERENCE TEST	PUSH	+20	7/31/96
NOFLOW051	SAND (WET)	SCOPING - SAND INTERFERENCE TEST	PUSH	2.56	7/31/96
NOFLOW052	NONE	SCOPING PRESSURE TEST	ROTARY	2.35	8/1/96
NOFLOW053	NONE	SCOPING PRESSURE TEST	ROTARY	+20	8/1/96
NOFLOW054	NONE	SCOPING PRESSURE TEST	ROTARY	+20	8/1/96
NOFLOW055	NONE	SCOPING PRESSURE TEST	ROTARY	+20	8/1/96
NOFLOW056	NONE	SCOPING PRESSURE TEST	ROTARY	+20	8/1/96
NOFLOW057	NONE	SCOPING PRESSURE TEST	ROTARY	+20	8/1/96
NOFLOW058	SAND (WET)	0-2000 lbf, 6.5" PENETRATION, INSERT "F"	ROTARY	5.13	8/26/96
NOFLOW059	SAND (WET)	0-2000 lbf, 9", INSERT "E"	ROTARY	3.85	8/26/96
NOFLOW060	SAND (WET)	0-2000 lbf, 9" INSERT "D"	ROTARY	5.35	8/26/96
NOFLOW061	SAND (WET)	0-2000 lbf, 9" INSERT "F"	ROTARY	4.92	8/26/96
NOFLOW062	SAND (WET)	0-2000 lbf, 9" INSERT "E"	ROTARY	4.28	8/26/96
NOFLOW063	SAND (WET)	0-2000 lbf, 9", INSERT "F"	ROTARY	4.92	8/26/96
NOFLOW064	SAND (WET)	0-2000 lbf, 9"+, INSERT "D", QUADRALATCH SLIPPED	ROTARY	5.35	8/26/96
NOFLOW065	SAND (WET)	0-2000 lbf, 9", INSERT "E"	ROTARY	4.06	8/26/96
NOFLOW066	SAND (WET)	0-2000 lbf, 9", INSERT "F"	ROTARY	4.92	8/26/96
NOFLOW067	SAND (WET)	0-2000 lbf, 9", INSERT "D"	ROTARY	5.14	8/26/96
NOFLOW068	SAND (WET)	0-2000 lbf, 9", INSERT "E"	ROTARY	4.28	8/26/96
NOFLOW069	SAND (WET)	0-2000 lbf, 9", INSERT "C"	ROTARY	4.92	8/26/96
NOFLOW070	SAND (WET)	0-2000 lbf, 9"+, INSERT "A", QUADRALATCH SLIPPED - REPLACED CORE BARREL	ROTARY	5.35	8/26/96
NOFLOW071	SAND (WET)	0-2000 lbf, 9", INSERT "A"	ROTARY	5.14	8/26/96

TEST #	SIMULANT TYPE	DESCRIPTION	INSERT TYPE	PURGE LEAK RATE (SCFM)	DATE
NOFLOW072	SAND (WET)	0-2000 lbf, 9", INSERT "B"	ROTARY	5.78	8/26/96
NOFLOW073	SAND (WET)	0-2000 lbf, 9", INSERT "C"	ROTARY	5.14	8/26/96
NOFLOW074	SAND (WET)	0-2000 lbf, 9", INSERT "A"	ROTARY	4.92	8/26/96
NOFLOW075	KAOLINITE	Prep for remaining tests.	ROTARY	2.78	8/27/96
NOFLOW076	KAOLINITE	6" PENETRATION, INSERT "B"	ROTARY	4.07	8/27/96
NOFLOW077	KAOLINITE	6" , INSERT "C"	ROTARY	3.64	8/27/96
NOFLOW078	KAOLINITE	6", INSERT "A"	ROTARY	2.78	8/27/96
NOFLOW079	KAOLINITE	6", INSERT "B"	ROTARY	4.07	8/27/96
NOFLOW080	KAOLINITE	6", INSERT "C"	ROTARY	3.85	8/27/96
NOFLOW081	KAOLINITE	6", INSERT "A"	ROTARY	3.21	8/27/96
NOFLOW082	KAOLINITE	6", INSERT "B"	ROTARY	4.50	8/27/96
NOFLOW083	KAOLINITE	6", INSERT "C"	ROTARY	3.43	8/27/96
NOFLOW084	KAOLINITE	6", INSERT "D"	ROTARY	4.50	8/27/96
NOFLOW085	KAOLINITE	6", INSERT "E"	ROTARY	3.00	8/27/96
NOFLOW086	KAOLINITE	6", INSERT "F"	ROTARY	3.64	8/27/96
NOFLOW087	KAOLINITE	6", INSERT "D"	ROTARY	4.06	8/27/96
NOFLOW088	KAOLINITE	6", INSERT "E"	ROTARY	2.99	8/27/96
NOFLOW089	KAOLINITE	6", INSERT "F"	ROTARY	3.63	8/27/96
NOFLOW090	KAOLINITE	6", INSERT "D"	ROTARY	4.27	8/27/96

Table 4 - Rotary Insert Information

Race Set Identifier	O.D of Inner Race (Inches)	I.D. of Outer Race (Inches)	Relative ease of movement between races	Initial leak check @ 90 PSI (SCFM)
A	1.3651	1.3671	Average	3.85
B	1.3651	1.3671	Average	5.57
C	1.3652	1.3671	More difficult	4.92
D	1.3651	1.3675	Easy to move	5.14
E	1.3651	1.3672	Average	3.85
F	1.3650	1.3674	Easy to move	4.92

* Note that the leak check included all leaks in the system, i.e. , drill string connections, camlock fittings, rotary joint, etc.

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WHC-SD-WM-TRP-264, REV 0 REPORT ON THE TESTING OF THE NO-FLOW PUSH BIT / NH43B		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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