

Sheet 2
JAN 06 2000

ENGINEERING DATA TRANSMITTAL

Page 1 of 1
1 EDT 628503

2 To (Receiving Organization) Documentation and Records Mgmt		3 From (Originating Organization) Technical Integration (FSA 13300)		4 Related EDT No EDT 628503	
5 Proj /Prog /Dept /Div Spent Nuclear Fuel Project		6 Design Authority/Design Agent/Cog Engr D M Chenault		7 Purchase Order No 00003170	
8 Originator Remarks Project filing of the Fuel Basket Handling Grapple Design Development Report and the Fuel Basket Handling Grapple Acceptance Test Report (Production Grapples) Two Reports by MCE Engineering <i>USQ SUBMITTING EXCLUDED PER B CARPENTER (CATEGORICAL EXCLUSION)</i>				9 Equip /Component No DES-12-1 (001 to009)	
				10 System/Bldg /Facility SNF/KE & KW/100K	
				12 Major Assm Dwg No Vendor MCE DES-12-1	
				13 Permit/Permit Application No N/A	
11 Receiver Remarks 11A Design Baseline Document? <input type="radio"/> Yes <input checked="" type="radio"/> No Design Development report verifies the design adequacy per tested verification of required safety factors The acceptance test report verifies each production grapple has been proof tested as required				14 Required Response Date	

15 DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No	(B) Document/Drawing No	(C) Sheet No	(D) Rev No	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	SNF-5567	N/A	0	SNF Storage Projects Fuel Basket Handling Grapple Design Development Test Report	N/A	2	1	1
2	SNF-5568	N/A	0	MCE Engineering Test Rept Fuel Basket Handling Grapple Acceptance Test	N/A	2	1	1

16 KEY		
Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E S Q D O R N/A (See WHC CM 3-5 Sec 12.7)	1 Approval 2 Release 3 Information 4 Review 5 Post Review 6 Dist (Receipt Acknow Required)	1 Approved 2 Approved w/comment 3 Disapproved w/comment 4 Reviewed no/comment 5 Reviewed w/comment 6 Receipt acknowledged

17 SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)											
(G) Reason	(H) Disp	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp	(J) Name	(K) Signature	(L) Date	(M) MSIN
1	1	Design Authority D M	<i>D M Chenault</i>	<i>12-14-99</i>	R3-86	3		J Weamer			X3-85
		Design Agent				3		J M Henderson			X3-88
		Cog Eng				3		J D Mathews			X3-65
1	1	Cog Mgr D W	<i>D W Medford</i>	<i>01-03-00</i>	R3-86	3		T J Ruane			X3-72
		QA									
		Safety						<i>SNF file</i>			<i>R3-11</i>
		Env									

18 <i>Douglas M Chenault</i> D M Chenault Signature of EDT Originator Date <i>12-14-99</i>	19 Authorized Representative for Receiving Organization Date	20 <i>D W Medford</i> D W Medford Design Authority/Cognizant Manager Date <i>01-03-00</i>	21 DOE APPROVAL (if required) Ctrl No _____ <input type="radio"/> Approved <input type="radio"/> Approved w/comments <input type="radio"/> Disapproved w/comments
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SNF STORAGE PROJECTS FUEL BASKET HANDLING GRAPPLE DESIGN DEVELOPMENT TEST REPORT

D M Chenault
Fluor Hanford Incorporated Richland WA 99352
U S Department of Energy Contract DE AC06 96RL13200

EDT/ECN 628503 UC 510
Org Code YA300 Charge Code 105528/DA00
B&R Code EW7040000 Total Pages 64

Key Words Grapple Basket Fuel Loading

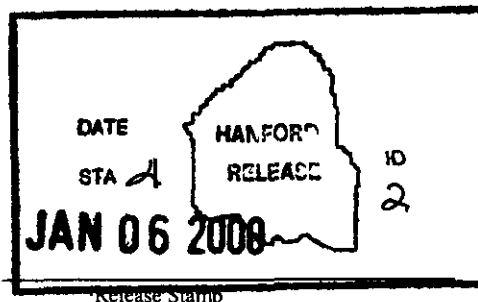
Abstract Acceptance testing of the SNF Fuel Basket Lift Grapple was accomplished to verify the design adequacy
This report shows the results affirming the design

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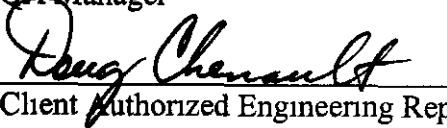

Release Approval Date 01/05/00



Approved for Public Release

SNF STORAGE PROJECTS
FUEL BASKET HANDLING GRAPPLE DESIGN DEVELOPMENT
TEST REPORT

Revision 0

Approved by	 Engineering	<u>5/29/99</u> Date
Concurred by	 QA Manager	<u>5/27/99</u> Date
Concurred by	 Client Authorized Engineering Rep	<u>6/8/99</u> Date

SNF STORAGE PROJECTS FUEL BASKET HANDLING GRAPPLE INCONEL ACTUATOR SHAFT AND ENGAGEMENT BALL TEST REPORT

1.0 BACKGROUND

In January of 1997, MCE Engineering completed acceptance testing of a unique grapple designed to lift Multi Canister Overpack (MCO) Baskets. Testing was performed at design basis load (nominally 3200 pounds), 3X design basis load, and 5X design basis load. The load testing proved the adequacy of design by demonstrating that local yielding of the actuator shaft, end effector, and receptacle was consistent with pre-test analysis and that post test non-destructive examination proved the components to be free from cracks and defects.

Testing did indicate a potential problem with the engagement ball retaining method and as a result, a new design was developed and subsequently approved. Additional production grapples were fabricated and each was tested per applicable requirement of ANSI N.14.6 - load testing of 150% of design basis load followed by liquid penetrant or magnetic particle examination in accordance with ANSI/ASME Boiler and Pressure Code, 1989, Section III, Division 1.

Based upon independent materials compatibility analysis of the grapple and associated components, the 440C material used in the grapple engagement balls and actuator shafts has been replaced with Inconel 718. As a result, MCE has performed 3X and 5X load testing on one of the grapple assemblies to verify the Inconel 718 material meets acceptance criteria. This document presents the data and summarizes the results of that testing.

1.0 TEST OBJECTIVES - ACCEPTANCE CRITERIA

The primary objective of this testing is to confirm stress design criteria for the Grapple Assembly (MCE Drawing DES-1-1 Latest Revision). Specifically, tests directed towards verifying and demonstrating the overall grapple concept with respect to the minimum yield case (taken as three times the dead weight per Section 4 2 1 1 of the ANSI standard), off-normal load capacity (taken as five times the dead weight per the ANSI standard). The acceptance criteria for the grapple is as follows:

- Local yielding of the inconel actuator shaft and engagement balls shall be within expected limits when test articles subjected to 3X overload
- No failure of grapple assembly when test articles subjected to 5X overload
- Acceptable Die Penetrant testing showing no load induced cracks or defects in actuator shafts pending tests

3 0 BASIS FOR TESTING

The test was to be conducted using Test Procedure EP#11, Rev 0. The completed Test Procedure, along with data sheets for each grapple tested is included as Appendix A to this report. The design load specified for this grapple is 3200 pounds. The required test load is thus $(3200)(3) = 9600$ pounds and $(3200)(5) = 16,000$ pounds.

4 0 TEST DESCRIPTION

The test was performed using the test setup described in Appendix A. The test hardware was the prototype grapple which had been designed and fabricated by MCE Engineering, based on a detailed design provided by the client. The test fixture consists of a load reacting cylinder mechanism which transfers load from a hydraulic cylinder through the grapple to a lower plate which is fastened to the mating portion of the grapple. The loading device is a 0 to 10,000 psig double acting Enerpac hydraulic cylinder. Loading was monitored by a calibrated 0 to 10,000 psig Ashcroft gage.

The test was conducted at MCE Engineering's fabrication division, G&M Manufacturing. The test was witnessed by the client engineering and quality assurance representatives. Prior to starting testing activities, pre-test activities including a safety briefing and verification of the calibration status of test equipment was performed and documented. This signed data sheet is provided as Appendix B. The Ashcroft gage was calibrated by Bellhaven. Calibration of the Ashcroft gauge found the gauge to read in error by nominally 25% low. The five point calibration curve was used to correct readings taken from the gauge to actual pressure and corresponding load. However, during testing the correction calculation was incorrectly applied and the test pressure and loads were significantly over applied. This resulted in testing each of the test articles at loads much greater than the target loads. See Table 5.1 for actual test loads. Appendix B of this report also includes copies of the Ashcroft calibration data and calculations.

5 0 SUMMARY RESULTS

5.1 Design Basis Test Load

Per the approved test procedure, three tests were performed. In the first of these tests, the test articles were to be subjected to nominally design basis loads for a minimum of 10 minutes. However, as shown in Table 5.1, due to the incorrect application of the correction factor for the pressure gauge, the applied test load was in fact 7473 pounds (2.3X Design Load). A dial indicator was used to monitor total assembly deflection as the load was applied and maintained for 10 minutes. Total deflection was measured to be .023" and no movement of the assembly was indicated during the 10 minute hold cycle.

Following application of the load, the test apparatus was disassembled and examined for local yielding. Small indentations or "dimples" were found on the inconel actuator shaft and engagement balls. However, these dimples were consistent with pre-test expectations and did not alter the function of the grapple assembly.

Data sheets for this test are shown in Appendix C Pre and post test dimensional measurements are recorded in Appendix D

5 2 3X Design Basis Test Load

In the second test, the test articles were planned to be subjected to nominally 3X design basis loads for a minimum of 10 minutes However, as shown in Table 5 1, due to the incorrect application of the correction factor for the pressure gauge, the applied test load was in fact 18,108 pounds (5 6X Design Load) A dial indicator was used to monitor total assembly deflection as the load was applied and maintained for 10 minutes Total deflection was measured to be .091 ' and no movement of the assembly was indicated during the 10 minute hold cycle No permanent deflection of the grapple was noted

Following application of the load, the test apparatus was disassembled and examined for local yielding Small indentations or "dimples" were found on the inconel actuator shaft and engagement balls However, these dimples were consistent with pre test expectations and did not alter the function of the grapple assembly

Data sheets for this test are shown in Appendix E Pre and post test dimensional measurements are recorded in Appendix D

5 3 5X Design Basis Test Load

In the third test, the test articles were planned to be subjected to nominally 5X design basis loads for a minimum of 10 minutes However, as shown in Table 5 1, due to the incorrect application of the correction factor for the pressure gauge, the applied test load was in fact 28,744 pounds (8 9X Design Load) A dial indicator was used to monitor total assembly deflection as the load was applied and maintained for 10 minutes Total deflection was measured to be .118" and no movement of the assembly was indicated during the 10 minute hold cycle

Following application of the load, the test apparatus was disassembled and examined for local yielding Small indentations or "dimples" were found on the inconel actuator shaft and engagement balls However, these dimples were consistent with pre-test expectations and did not alter the function of the grapple assembly

Data sheets for this test are shown in Appendix F Pre and post test dimensional measurements are recorded in Appendix D

Table 5 1 Summary of Test Conditions

TEST ID	Test Type	Displayed Pressure	Corrected Pressure	Calculated Load	Comments
Test A1	Design Basis 3200 Pound	1050	1586 71	7473 40	Load tested to 233% Of Design Basis Load No change in engagement ball diameter
H 1 82864 010 001 Retaining Wire Design	3X Design 9600 Pound	2800	3844 77	18108 89	565% Of Design Basis Load Post test dimple on actuator shaft nominal 002 003 diameter No change in engagement ball diameter
H 1 82864 010 001 Retaining Wire Design	5X Design 16 000 Pound	4550	6102 84	28744 37	898% Of Design Basis Load Post test dimple on actuator shaft nominal 004 diameter No change in engagement ball diameter

5 4 Additional Test Data

Following load tests all inconel actuator shafts were liquid penetrant inspected per ASME Section III, Division 1 1989 and accepted per requirements of NF-5350 This examination was performed to insure that no cracking had occurred The examination reports, and copies of the NDE procedure and inspector qualifications are included as Appendix G of this document

A copy of the fabrication drawing for the grapple assembly and material certifications for the inconel actuator shaft material, is included as Appendix H

6.0 Conclusions

The test was successful in demonstrating the adequacy of the grapple assembly's inconel actuator shaft and engagement balls for in loads excess of design basis loads (3200 pounds), 3X design basis loads (9600 pounds), and 5X design basis loads (16,000 pounds)

The test data showed that no appreciable yielding for the inconel actuator shaft and engagement balls at loads in excess of 5X Design Basis loads. The test data also showed the grapple assembly and components to be fully functional after loads in excess of 5X Design Basis were applied and maintained for over 10 minutes

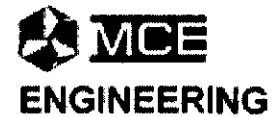
Following testing, each actuator shaft (Item 7) was liquid penetrant inspected per ASME Section III, Division 1 1989 and accepted per requirements of NF-5350. This examination was performed to insure that no cracking had occurred. The test indicated that no cracking had occurred. The examination reports are included as Appendix C to this document.

From this test, it is concluded that the design configuration meets or exceeds the requirements specified in ANSI N 14.6 for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More.

Appendix A

MCE Engineering Procedure #9, Rev 0


Fuel Basket Handling Grapple



SNF STORAGE PROJECTS
FUEL BASKET HANDLING GRAPPLE DESIGN DEVELOPMENT
TEST PROCEDURE

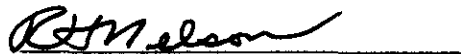
MCE-EP-011 Rev 0

Prepared by


Engineering

5/3/99
Date

Concurred by


QA Manager


5/3/99
Date

Concurred by


Client Authorized Engineering Rep

5/3/99
Date

Concurred by


Client Authorized QA Rep

3 May 99
Date

SNF STORAGE PROJECTS FUEL BASKET HANDLING GRAPPLE INCONEL ACTUATOR SHAFT AND ENGAGEMENT BALL TEST PROCEDURE

1 0 INTRODUCTION

In January of 1997, MCE Engineering completed acceptance testing of a unique grapple designed to lift Multi Canister Overpack (MCO) Baskets. Testing was performed at design basis load (nominally 3200 pounds), 3X design basis load, and 5X design basis load for verification that gross deformation at 3X load and failure at 5X load did not occur. The load testing proved the adequacy of design by demonstrating that local yielding of the actuator shaft, end effector, and receptacle was constant with pre-test analysis and that post test non destructive examination proved the components to be free from cracks and defects.

Testing did indicate a less than desirable engagement ball retaining method and as a result, a new design was developed and subsequently approved. Additional production grapples were fabricated and each was tested per applicable requirement of ANSI N 14.6 - load testing of 150% of design basis load followed by liquid penetrant or magnetic particle examination in accordance with ANSI/ASME Boiler and Pressure Code, 1989, Section III, Division 1.

Based upon independent materials compatibility analysis of the grapple and associated components, the 440C material used in the grapple engagement balls and actuator shafts has been replaced with Inconel 718. As a result, MCE has been directed to perform 3X and 5X load testing on *one* of the grapple assemblies to verify the Inconel 718 material meets acceptance criteria. This document defines test methodologies, acceptance criteria, and test data sheets for these acceptance tests. Upon successful completion of the tests, MCE shall perform 150% acceptance tests on *each* of the grapple assemblies repaired by MCE. This additional qualification testing shall be performed to Mid Columbia Engineering EP# 9 (Fuel Basket Handling Grapple Load Test Procedure).

2 0 TEST OBJECTIVES

The primary objective of this testing is to confirm stress design criteria for the Grapple Assembly (MCE Drawing DES-1-1 Latest Revision) Specifically, tests directed towards verifying and demonstrating the overall grapple concept with respect to the minimum yield case (taken as three times the dead weight per Section 4 2 1 1 of the ANSI standard), off-normal load capacity (taken as five times the dead weight per the ANSI standard

Please note that analysis and testing performed by MCE in 1997 indicate that local yielding of the grapple body, actuator shaft and basket interface groove is expected Post test measurements of the local yielding will be taken and compared with previous test results to determine of the Inconel 718 is an acceptable substitute for the 440C In addition during pull testing, measurements of "gross deflection" will be taken with a dial indicator to determine if yielding reaches a limit during the 10 minute hold cycle

Finally, pre and post test non destructive examination will be performed on test articles to confirm the absence of any load induced crack or defects

3 0 TEST SCOPE

3 1 General

The material/equipment strength tests described in this document will be performed for Duke Engineering & Services Hanford, Inc (DESH) and/or DESH's authorized representative Therefore, testing to be performed in accordance with this document requires DESH representation in order to be considered valid

3 2 Test Articles

The grapple end effector test articles, the receptacle test articles, and the grapple assembly test chamber, shall be fabricated and assembled in accordance with the following MCE Engineering drawings

<u>Document NO.</u>	<u>DESCRIPTION</u>
DES 12 1 Latest Revision	Fuel Basket Grapple Assembly
40698 Fax Chenault to Wheat	Fuel Basket Receptacle Interface Sketch

4 0 TEST PREPARATION & APPROACH

4 1 General Safety

Standard industrial/shop safety practices shall be followed during the testing of the grapple assembly to assure the safety of workers in the affected areas. The test area shall be isolated during pull tests. Test equipment shall be safety inspected prior to use. Prior to the start of each day's test activities, the test director shall conduct a pre-job briefing. Tests will be discussed and safety issues identified.

4 2 Recording As-built Data

After completion of fabrication, as-built data, including examination and characterization of the test articles, shall be recorded in the appropriate appendices for the end effector and receptacle interface test articles. Required material certifications shall be verified.

4 3 Assembly of Grapple Receptacle and End Effector

After the test article as-built tolerances and observations have been recorded, the fabrication pieces shall be assembled in accordance with fabrication drawings DES-1-1. The grapple receptacle and end effector assembly shall be demonstrated functional by raising and lowering the actuator rod to engage and release the receptacle interface piece.

4 4 Test Approach

The grapple end effector and receptacle interface will be tested by placing the assembly in a fabricated test chamber. The receptacle is mounted and secured to the test chamber end cap. A hydraulic cylinder is attached to the opposite end of the test chamber, and the grapple end effector is attached to the hydraulically controlled piston. This assembly is mounted on a metal plate for stability.

Hydraulic pressure is provided by a hydraulic pump, and is manually controlled. Pressure is monitored with a calibrated pressure indicating gage mounted at the cylinder inlet connection for piston retraction. When hydraulic pressure is applied to retract the piston, a "pull" force is exerted on the grapple end effector and receptacle assembly. As the hydraulic pressure is increased, physical displacement is recorded versus time as well as pressure versus time. Assuming that the test article survives each preceding test, it will be tested at 9600 pounds and 16,000 pounds. Following initial testing, a hold point has been established to review the test data prior to authorizing the planned failure test. The hydraulic cylinder is rated at 23 tons in the retraction direction.

After each test, the test assembly will be disassembled to the point where it will be possible to demonstrate the functional ability of the test article. After a functional demonstration, the grapple end effector and receptacle assembly will be completely disassembled, visually inspected and measured in comparison with the recorded as-built condition for each piece. The individual test results will be recorded by and evaluated by DESH and MCE, and additional testing will be performed as deemed appropriate per the test objectives and the results of the previous testing. The test results may result in subsequent test article fabrication that is revised from the previous test article. New/revised design configurations shall be noted appropriately on the affected test data sheet. The tests will be repeated with the revised test article at the discretion of DESH and the MCE Test Coordinator with additional test articles.

4.5 Equipment Calibration

Calibration for pressure instrumentation and dimensional measuring devices used for the performing tests in this procedure shall be calibrated and documented.

4.6 Performing Load Tests

In each test, the grapple assembly is loaded by applying a force generated by a hydraulic cylinder that is manually controlled. The maximum operating pressure of the hydraulic pump is 10,000 psig. The hydraulic cylinder is rated at nominally 23 tons (46,000 lbs) at 10,000 psig in the retraction/pull mode used for these tests. The cylinder's cross section area is 4.71 square inches in the retraction mode. Thus for a pull force of 9600 pounds, the pressure must be 2038.2 psig, and for a pull force of 16,000 pounds, the pressure must be 3397.03 psig.

The pressure will be applied in increments as noted on the individual data sheets for the specific load/pull tests, and measurements and observations will be recorded. When the target pull force is obtained, pressure will be maintained for at least ten minutes. During this time period, displacement will be measured and physical observations will be recorded for material creep. Pressure will be recorded at the beginning and end of each hold period.

5.0 TESTING/ACCEPTANCE CRITERIA

5.1 Grapple Receptacle Design Concept Evaluation

5.1.1 Receptacle Load Capacity

The receptacle shall be evaluated after the 9600-pound load test and the 16,000-pound load test.

5 2 Grapple End Effector Design Concept

5 2 1 Evaluate End Effector Performance

The end effector shall be evaluated after the 9600 pound load test and the 16,000 pound load test

6 0 PROCEDURE FOR PERFORMING TESTS

Appendices shall be used for performing, recording and verifying tests Tests shall be conducted with the presence of a Duke Engineering & Services Hanford authorized representative

6 1 Receptacle Testing

The following tests shall be conducted on the first receptacle test article Testing will be conducted on subsequent test articles following evaluation of the initial testing

6 1 1 Load Capacity Testing

6 1 1 1 Ultimate Tensile Strength Criteria Testing

After completion of the testing and characterization listed in Appendix A, the receptacle test article shall be tested against a 16,000-pound hydraulic load After the load has been removed, the receptacle test article shall be demonstrated functional prior to complete disassembly Following this single load cycle, the receptacle test article shall be examined for the parameters listed in Appendix C to identify and record any changes

6 2 End Effector Testing

6 2 1 Performance Evaluation

Results obtained from the testing described in 6 1 1 above shall be combined with the end effector inspections/measurements to evaluate the performance of the end effector test article

In accordance with Appendix A, the end effector shall be load tested to 9600 pounds Afterward, the test setup shall be partially disassembled (the chamber is removed) to allow a functional demonstration of the end effector and receptacle assembly prior to complete disassembly for part inspection in accordance with Appendix A

Particular care shall be taken to identify and characterize any local yielding of the body (particularly the lower surfaces of the ball races that receive the load from the balls), the actuator shaft (particularly that portion of the shaft that receives reaction loads from the balls), and the detent balls themselves

6 2 1 2 Ultimate Tensile Strength Criteria Testing (refer to Appendix B)

After completion of the testing and characterization listed in Appendix B, the receptacle test article shall be tested against a 16,000-pound hydraulic load. After the load has been removed, the test setup shall be partially disassembled (the chamber is removed) to allow a functional demonstration of the end effector and receptacle assembly prior to complete disassembly for part inspection in accordance with Appendix B to identify and record any changes.

Particular care shall be taken to identify and characterize any local yielding of the body (particularly the lower surfaces of the ball races that receive the load from the balls), the actuator shaft (particularly that portion of the shaft that receives reaction loads from the balls), and the detent balls themselves.

6 3 Test Data

The primary record data for this series of tests will be the completed test data sheets. Load data (from the calibrated pressure gauge), and displacement data (from pre and post test measurements and in process laser measurements), along with observations will be recorded on the appropriate data sheets. Other record data includes material certifications, photographic records, and electronic data files.

- Completed Test Data Sheets
- Material Certifications
- Photographic records
- Electronic Data

6 3 1 Qualitative Measurements

Qualitative measurements include observations about the appearance, sound or other non-quantitative measurements collected during test performance. This includes observations recorded on the test data sheets and video and photographic records. During performance of the test, Qualitative measurements shall be collected, indexed to the appropriate procedure step, and transmitted to the customer with the final data report.

6 3 2 Quantitative Measurements

Quantitative measurements including load and displacement will be measured by MCE Engineering personnel or their designee and recorded on test data sheets. Customer witness of each data collection activity is expected but is NOT considered an Engineering or Quality Hold Point. However, there is a hold point for Client review and approval upon completion of each test in the series. This hold point must be cleared prior to beginning the next test in the series.

6 3 3 Measurement Ranges and Accuracy

The test loads specified in this procedure are nominal. The test performer shall apply the nominal load and record the actual load in the data sheet. The minimum increment for the pressure gauge is 100 psi. It is reasonable that the pressure can be recorded to the nearest 50 psi. Data shall be recorded in accordance with the tolerances specified on the forms in Appendices A, B, C, D, and E. Loads applied to the test fixture are derived by dividing the applied pressure by the specified effective cylinder area in retraction. For the Enerpac RRH-307 cylinder used for this test, the effective cylinder area in retraction is specified to be 4.71 square inches. Thus, the corresponding pressure for a 3200 pound load is 679.4 psig, a 9600 pound load is 2038.2 psig, and a 16,000 pound load is 3397.02 psig. All required pressures have been rounded up in the test procedure data sheets.

7 0 QUALITY ASSURANCE

7 1 Quality Assurance Oversight

7 1 1 MCE Engineering Quality Assurance

MCE Quality assurance shall have the responsibility for review and concurrence of this procedure. MCE Quality Assurance will also provide review and concurrence of the final test report. MCE Quality Assurance witness of the testing is not required.

7 1 2 Duke Quality Assurance

Duke Engineering shall have the responsibility for review and concurrence of this procedure and subsequent test report. In addition, a representative from the appropriate Duke Quality Assurance organization observe test activities.

7 2 Instrument/Equipment Calibration

The measuring devices and the pressure gauge shall be currently calibrated, and documentation provided with the test report as a record.

8 0 TEST REPORT

A report shall be prepared presenting the recorded data and observations using completed Appendix A, B, and C. The report shall include a summary of the testing performed and the results of the evaluations during testing.

9 0 RESPONSIBILITY

9 1 MCE Responsibility

MCE Engineering will have two key persons associated with testing. The test director, or designated representative, is responsible for coordinating the preparation, review, obtaining client approvals, and issuing the test procedure. The test director will have the authority to make minor revisions to the test procedure in the interest of expediency where work scope is not affected, and the goal is to improve productivity. These revisions will be redlined into the working procedure, and documented with the test report as appropriate.

The MCE Engineering shop technician will be responsible for implementing the approved test procedure in the shop. Data may be recorded in the test procedure data sheets by the MCE Test Performer, Test Director, or Client Representative.

The MCE Test Director will be responsible for reviewing test data, interpreting results, and writing the test report.

9 2 Client Responsibility

The client has the responsibility to approve this procedure prior to implementation, witness and verify testing, and, when necessary, designate an authorized representative for these purposes. Revisions to the test procedure that affect the scope require client approval prior to proceeding with the revised test procedure.

10 0 CONFIGURATION CONTROL

Prior to initiating formal test activities this test procedure shall be approved and released into MCE Engineering's document control system. At the test director's and client's mutual agreement MINOR procedure changes can be implemented using red-line control. Red-line mark-ups to the test procedure shall be initiated by the MCE Test Director AND the Authorized Client Engineering Representative. MINOR procedure changes are changes which streamline test conduct or alter the sequence of test activities. MAJOR procedure changes which alter the scope or intent of testing requires signature approval commensurate with original document release and requires a direct revision to this procedure.

Appendix B
Calibration Data Sheets

PRE-TEST ACTIVITIES

- 1) Identify Test Participants and sign data sheet

Title	Name	Signature	Initials
MCE Test Director	ERIC STRICKLAND	<i>[Signature]</i>	ES
MCE Test Performer	ERIC STRICKLAND	<i>[Signature]</i>	ES
Authorized Client Engineering Representative	DOUG CHENAVANT	<i>[Signature]</i>	DC
Authorized Client QA Representative	GEORGE MATTA	<i>[Signature]</i>	GM
Other (Identify)	N/A	N/A	N/A
Other (Identify)	N/A	N/A	N/A

- 2) Record information for measurement and test equipment As a minimum record model number serial number and calibration data for the Pressure Gauge and dimensional measurement gauges (Blocks micrometer gauges etc)

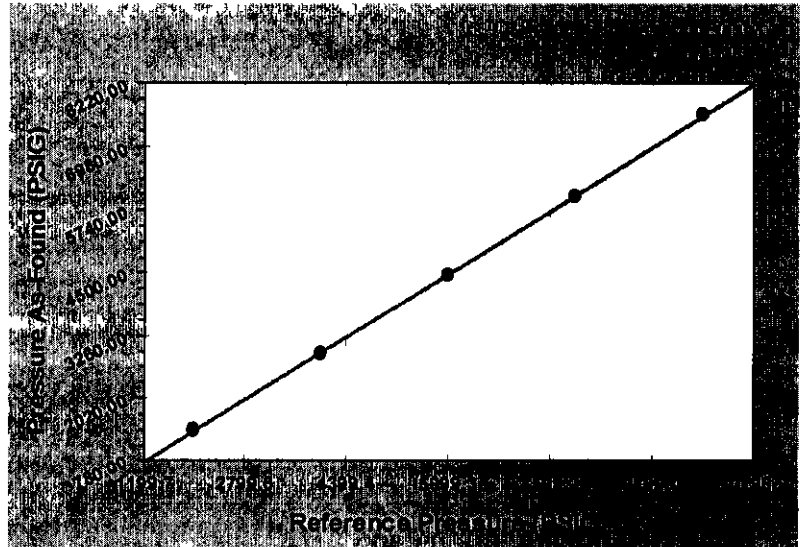
Description - Model	Serial Number	Calibration Data (Include Expiration Date)	Verified By
Askerfelt Gauge	Q8451	CAL-99-95 5/21/99	MLC 5/3/99
Micrometer	GM01	10/99	ES 5/3/99
Micrometer	GM03	10/99	ES 5/3/99
Micrometer	GM09	10/99	ES 5/3/99

Ashcroft Calibration Data TAG NO BEL99 251 Expires 5/5/2000

Reference Pressure Ashcroft Displayed

1999 629	1400
3999 188	2900
5999 123	4450
7999 107	6000
9998 968	7600

Pressure As Found = $179.7 + 775(\text{Actual Pressure})$
or
Actual Pressure = $(\text{As Found Pressure} + 179.7) / 775$



Test Load = Actual Pressure Area of Cylinder
Where Area of Cylinder = 4.71 Square Inches

Test Load = $((\text{Ashcroft Pressure} + 179.7) / 775) \times 4.71$

Ashcroft Pressure	Actual Pressure	Test Load	Overload
1650	2360.90	11119.85	3.474954
1700	2425.42	11423.73	3.569914
1650	2360.90	11119.85	3.474954
1650	2360.90	11119.85	3.474954
1650	2360.90	11119.85	3.474954
1600	2296.39	10815.98	3.379995
1650	2360.90	11119.85	3.474954
1700	2425.42	11423.73	3.569914
2807	3853.81	18151.43	5.672321

Belhaven

Applied Technologies

Customer

Midcolumbia Engineering

Certificate of Calibration

Tag BEL99-251

Model

Manufacturer Ashcroft

Instrument Pressure Gauge

Serial No

Calibration traceable to the National Institute of Standards and Technology in accordance with ANSI- Z540 1 has been accomplished on the above-named instrument by comparison with standards maintained by Belhaven. The accuracy and stability of all standards maintained by Belhaven are traceable to national standards maintained by the National Institute of Standards and Technology in Washington, D C and Boulder, Colorado

Temperature at Calibration 68 F

Accuracy of Instrument 25%

Calibrated Range 10000 PSI

Calibration Report No BEL99-251

Date Due 5/5/2000

Test Equipment

Ametek Deadweight Tester, S/N 16132

RECORD COPYLog F-7 By RHKDate 5/11/99

Calibrated by

Sam S 5-5-1999

Certified by

A Cadwell 5-5-99

Quality Assurance Manager

ORIGINAL

SNF-5567, new

Tag No BEL99-251

Instrument Type Pressure Gauge

Manufacturer Ashcroft

Serial No

Model

Cal Due Date 5/5/2000

System

Special Instructions LIMITED CALIBRATION This guage does not meet mfg tolerances The gauge is certified to have an accuracy of +/- 25% FS (2500 PSI)

		Cal Point	As Found	As Left	% Full Scale Accuracy
Units	PSI	1999 629	1400	1400	-5 9963
F.S. Accuracy	25%	3999 188	2900	2900	-10 9919
F.S. Accuracy		5999 123	4450	4450	-15 4912
Full Scale	10000	7999 107	6000	6000	-19 9911
Permitted Variation	2500 0000 PSI	9998 968	7600	7600	-23 9897
Cal Temp	68 F				

Test Equipment Ametek Deadweight Tester, S/N 16132

Calibration Performed By

[Signature]

Date

5-5-1999

ORIGINAL

Appendix C

Design Basis Load Test Data Sheets



A.1 3200 POUND LOAD TEST PRE-TEST MEASUREMENTS FOR RECEPTACLE INTERFACE

Perform and record the following measurements prior to test assembly of the receptacle

RECEPTACLE INTERFACE TEST					
ARTICLE No 004					
DESCRIPTION OF MEASUREMENT	DIMENSION PER DWG	PRE TEST DIMENSION	POST TEST DIMENSION	COMMENTS	MEASURED BY/ DATE
Outside Diameter inches (3 places)	2.375 ± .005	See DS-01	See DS-01	See Data Sheet	See Data Sheet
Measure Overall Length of Receptacle	8.0 ± .1	See DS-01	See DS-01	See Data Sheet	See DS

A.2 END EFFECTOR TEST ARTICLE AS-BUILT VERIFICATION

Perform and record the following measurements

END EFFECTOR TEST ARTICLE					
No H-1-82864-010-001					
DESCRIPTION OF MEASUREMENT	DWG DIMENSION & TOLERANCE DES 12.1 Rev 1	PRE TEST DIMENSION	POST TEST DIMENSION	COMMENTS	MEASURED BY/ DATE
Actuator Shaft O D inch	0.750 ± .005	1455 - .7465	See DS-01	Measure Dimples	See DS-01
Detent Ball O D inch	625 ± .0005	See DS 01	See DS-01	SEE Data Sheet	See DS-01

→ Dimples on Balls measured to be .075 x .1
 (Dimples on Shaft measured to be .075 x .1)
 Note: These are Post test measurements ELS



A.3 MECHANICAL CONNECTIONS VERIFICATION

Verify mechanical connections prior to 3200 pound test

A 4 APPLY 3200-POUND LOAD

Apply pressure in nominal 500 psig increments until 1000 psig is obtained. Note the pressure gauge is marked in 100 pound increments. Record actual pressure measurements to the degree practical, typically within 50 pounds. Record visual observations and analog data output from displacement indicator measurement at each increment.

243 MCE
5/14/11

Dist Indicator Zeroed w/ nominal 100 psig load

PSIG Nominal	PSIG Displayed	DISPLACEMENT READOUT	OBSERVATIONS	VERIFIED BY
500	560	0.010	Stable Displacement	<i>Shirley</i>
1000	1000	0.023	Stable Displacement	<i>Shirley</i>



A 4 Cont APPLY 3200 Pound Load

<p>Maintain target psig for minimum of 10 minutes</p> <p>Pressure, psig</p> <p>START TIME 11 32</p> <p>START PRESSURE 1160 PSI</p> <p>INTERIM TIME</p> <p>INTERIM PRESSURE</p> <p>FINISH TIME 11 42</p> <p>FINISH PRESSURE 1050 PSI</p>	<p>Record observations including any movement of stiff back/plunger interface connecting pin</p> <p>At t=0 displacement .025"</p> <p>At t=1 " .025"</p> <p>At t=5 " .025"</p> <p>At t=10 " .0255"</p>	<p>RECORDED BY</p> <p>EAS 5/3/07</p>
---	---	--------------------------------------

Appendix D
Dimensional Data

"FAX IT"

To:

SNF-5567, Rev 0

To THE ATTENTION OF:



FAX 509 535 8167

PHONE 509 535 0657

800-541 6354

DATA sheet 01

1000 PSI ~ 3200 lb Test

2800 PSI ~ 9600 lb Test

TEST #1 on Grapple H-1-82864-010-001

TEST to NORMAL, 3K & 5K LOAD (NORMAL = 3200 lbs)

FROM:

Company

P O / Job No

Your Name

Date

Phone

FAX No

Receiver

Before

AFTER

Thick

1 2 3258

2,385

2,430

2 2 3258

SAME

2,384

2,425

3 2,3258

2 387

2,430

Thin

1 2 326

Same

Same

2 2,376

3 2,326

overall LENGTH -

1- 8 0265

1000 PSI
8 0265

@ 2800 PSI
8,0265

8,0265

2- 8.026

8 027

8,026

8 0275

3- 8 027

8 026

8,026

8,0275

5-3/99
V.L.M.
D.M.
5-3-99

"FAX IT"

To:

SNF-5567, Rev 0

To THE ATTENTION OF:



DATA SHEET 002

FAX 509 535 8167

PHONE 509 535-0657

800 541 6354

Test # 1 on Grapple H-82864-010-001

Test to Normal, 3x & 5x Load (Normal = 3200 (bs))

FROM:

Company

P O / Job No

Your Name

Date

Phone

FAX No

ACTuator SHAST

7455

7465

some

Dimple Depth @ 2800 psi = .003 / .003

Dimple Depth @ 1500 psi = .004

Balls

1 625

2 .625

3 625

1000 # 3200 #
Pa
.623

2800psi 9600 #
.6203

.6165

.623

.6205

.616

.623

.6205

.616

5/3/99
Wd/M
Jme
53-99

Appendix E

3X Design Basis Load Test Data Sheets



B 1 9600 POUND LOAD TEST PRE-TEST MEASUREMENTS FOR RECEPTACLE INTERFACE

Perform and record the following measurements prior to test assembly of the receptacle

RECEPTACLE INTERFACE TEST ARTICLE No					
DESCRIPTION OF MEASUREMENT	DIMENSION PER DWG	PRE TEST DIMENSION	POST TEST DIMENSION	COMMENTS	MEASURED BY/ DATE
Outside Diameter inches	2.375 ± .005				
Measure Overall Length of Receptacle	8.0 ± .1				

B 2 END EFFECTOR TEST ARTICLE AS-BUILT VERIFICATION

Perform and record the following measurements

END EFFECTOR TEST ARTICLE No					
DESCRIPTION OF MEASUREMENT	DWG DIMENSION & TOLERANCE	PRE TEST DIMENSION	POST TEST DIMENSION	COMMENTS	MEASURED BY/ DATE
Actuator Shaft O D inch	0.750 ± .005				
Detent Ball O D inch	625 ± .0005			Measure Dimples	

See Data Sheet

See Data Sheet
SNF-5567, Rev 2
See Data Sheet 002



B.3 MECHANICAL CONNECTIONS VERIFICATION

Verify mechanical connections prior to 9600 pound test

B.4 APPLY 9600-POUND LOAD

Apply pressure in nominal 500 psig increments until 3000 psig is obtained. Note the pressure gauge is marked in 100 pound increments. Record actual pressure measurements to the degree practical, typically within 50 pounds. Record visual observations and analog data output from displacement indicator measurement at each increment.

PSIG Nominal	PSIG Displayed	DISPLACEMENT READOUT	OBSERVATIONS	VERIFIED BY
500	500	0.019	0.03"	ECS 5/2/97
1000	1000	0.038	0.013"	ECS 5/3/97
1500	1500	0.065		ECS 5/3/97
2000	2000	0.135		ECS 5/3/97
2500	2500	0.065		ECS 5/3/97
3000	3000	0.091		ECS 5/3/97
0				



B 4 Cont. APPLY 9600 Pound Load

Due

actual pressure 2440 vs 2807 psi

<p>Maintain 3000 psig for minimum of 10 minutes Pressure, psig</p> <p>START TIME 12 20 START PRESSURE 3000</p> <p>INTERIM TIME 12 25 INTERIM PRESSURE 2807</p> <p>FINISH TIME 12 30 FINISH PRESSURE 2800</p>	<p>Record observations including any movement of stiff back/plunger interface connecting pin</p> <p><i>To = Displacement .091"</i></p> <p><i>Disp = .091</i></p> <p><i>Disp = .091</i></p>	<p>RECORDED BY</p> <p><i>Due 5-3-99</i></p> <p><i>Due 5-3-99</i></p>
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Appendix F

5X Design Basis Load Test Data Sheets



C 1 16000 POUND LOAD TEST PRE-TEST MEASUREMENTS FOR RECEPTACLE INTERFACE

Perform and record the following measurements prior to test assembly of the receptacle

RECEPTACLE INTERFACE TEST					
ARTICLE No	DESCRIPTION OF MEASUREMENT	DIMENSION PER DWG	PRE TEST DIMENSION	POST TEST DIMENSION	COMMENTS
	Outside Diameter inches	2.375 ± .005			
	Measure Overall Length of Receptacle	8.0 ± .1			

2/15/14
See Date Sheet 01
See Date Sheet 01
2/15/14

C 2 END EFFECTOR TEST ARTICLE AS-BUILT VERIFICATION

Perform and record the following measurements

END EFFECTOR TEST ARTICLE					
No	DESCRIPTION OF MEASUREMENT	DWG DIMENSION & TOLERANCE	PRE TEST DIMENSION	POST TEST DIMENSION	COMMENTS
	Actuator Shaft O D inch	DES 12.1 Rev 1 0.750 ± .005			
	Detent Ball O D inch	62.5 ± .0005			Measure "Dimples"

2/15/14
See Date Sheet 01
2/15/14
See Date Sheet 01
DL



C.3 MECHANICAL CONNECTIONS VERIFICATION

Verify mechanical connections prior to 16000 pound test

C 4 APPLY 16000-POUND LOAD

Apply pressure in nominal 500 psig increments until 5000 psig is obtained Note the pressure gauge is marked in 100 pound increments record actual pressure measurements to the degree practical typically within 50 pounds Record visual observations and analog data output from displacement indicator measurement at each increment

PSIG Nominal	PSIG Displayed	DISPLACEMENT READOUT	OBSERVATIONS	VERIFIED BY
500	500	-0.013		CKS 5/3/94
1000	1000	0.001	0.013	CKS 5/3/94
1500	1500	0.040	0.019	CKS 5/3/94
2000	2000	0.054	0.026	CKS 5/3/94
2500	2500	0.068	0.033	CKS 5/3/94
3000	3000	0.103	0.039	CKS 5/3/94
3500	3500	0.137	0.049	CKS 5/3/94
4000	4000		0.079	CKS 5/3/94
4500	4050		0.118	CKS 5/3/94
5000				
0				

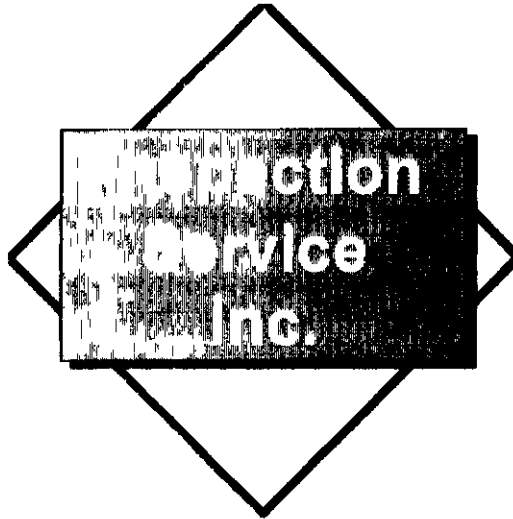


C 4 Cont APPLY 16000 Pound Load

<p>Maintain 5000 psig for minimum of 10 minutes Pressure, psig</p> <p>START TIME 1 35 START PRESSURE 4650</p> <p>INTERIM TIME INTERIM PRESSURE 1 45</p> <p>FINISH TIME 1 50 FINISH PRESSURE 4550</p>	<p>Record observations including any movement of stiff back/plunger interface connecting pin</p> <p>$T_0 = 0.119$ Pressure 6250 Final Displacement 1.19</p>	<p>RECORDED BY EKS 5/3/97</p>
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Appendix G

Non-Destructive Examination Reports and Certifications

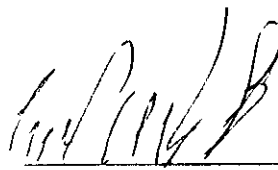


Liquid Penetrant Examination Procedure

**NDE 03
Rev 5**

Dated 3-9-98

Approval



H Samuel Wellenbrock President

1 0 Purpose

- 1 1 The purpose of this procedure is to establish governing requirements and provide specific instructions on the techniques and acceptance criteria to be utilized when performing, evaluation and documenting liquid penetrant examinations**

2 0 Scope

- 2 1 This procedure is in accordance with governing examinations criteria, as specified by referencing codes under which liquid penetrant examination is required**
- 2 2 This procedure is applicable to both ferrous and non ferrous, relatively non porous materials Thickness and size of objects to be examined is not a limiting factor**
- 2 3 This procedure meets the requirements of the ASME/ANSI codes and AWS Structural Welding Codes**

3 0 References

**ASME Boiler and Pressure Vessel Code Section III V and VIII
ASME/ANSI Power Piping Code B31.1
AWS Structural Welding Code D1.1
ASME/ANSI Chemical Piping Code B31.3**

4 0 Responsibilities

Individual responsibilities shall be as designated by Written Practice NDE-WP

5 0 Personnel Qualifications

- 5 1 Performance and interpretation of liquid penetrant examinations shall be accomplished only by level II or level III personnel**
- 5 2 Liquid penetrant examination personnel are qualified and certified in accordance with Written Practice NDE-WI**

6 0 Technique and Material

- 6 1 The following solvent removable color contrast liquid penetrant materials shall be used (or equivalent)**
- | | | |
|------------|-----------------------|--|
| (a) | Magnaflux Corp | Spotcheck SKC-S cleaner SKL-HSFL-S penetrant and SKD-S developer |
| | Sherwin Inc | Dubl-Chek DR-60 cleaner Dubl-Chek DP-40/DP-50 penetrant and Dubl-Chek D-100 developer |

6.2 PENETRANT MATERIALS

The term penetrant materials used in this procedure is intended to include all penetrants, solvents or cleaning agents, developers, etc. used in the examination process.

6.3 TECHNIQUE RESTRICTIONS

Fluorescent penetrant examination shall not follow a color contrast penetrant examination. Intermixing of penetrant materials from different family groups is not permitted. A retest with water washable penetrants may cause loss of marginal indications due to contamination.

6.4 CONTROL OF CONTAMINANTS

Certification of contaminant content shall be obtained and maintained for all liquid penetrant materials used on nickel base alloys, austenitic stainless steels, and titanium. These certifications shall include the penetrant manufacturers' batch numbers and the Section V, I 640.

7.0 Surface Preparation

- 7.1 In general, satisfactory results may be obtained when the surface of the part is in the as welded, as-rolled, as cast, or is forged condition. Surface preparation by grinding, machining, or other methods may be necessary where surface irregularities could mask indications due to discontinuities.

CAUTION BLASTING WITH SHOT OR DULL SAND MAY OPEN DISCONTINUITIES AT THE SURFACE AND SHALL NOT BE USED

- 7.2 Prior to all liquid penetrant examination, the surface to be examined and all adjacent areas within at least 1 inch shall be dry and free of all dirt, grease, lint, scale, welding flux, weld spatter, oil, and other extraneous matter that could obscure surface openings or otherwise interfere with the examination.

- 7.3 Typical cleaning agents which may be used are detergents, solvent remover, organic solvents, descaling solutions, and paint removers. Degreasing and ultrasonic cleaning methods may also be used.

NOTE Cleaning solvents shall meet the requirements of Paragraph 6.4.

- 7.4 After cleaning, drying of the surfaces to be examined shall be accomplished by normal evaporation or with forced hot air, as appropriate. A minimum of two (2) minutes shall be allowed to ensure that the cleaning solution has evaporated prior to application of the penetrant.

8.0 Examination Process

8.1 PENETRANT AND SPECIMEN TEMPERATURES

As a standard technique, the temperature of the penetrant and the surface of the part to be examined shall not be below 60 F (16C) nor above 125 F (52C) throughout the examination period. Local heating or cooling is permitted provided the part temperature remains in the range of 60 F to 125 F (16C to 52C) during the examination. Where it is not practical to comply with these temperature limitations, other temperatures and times may be used, provided the procedure is qualified as specified in Section 11.0.

8.2 PENETRANT APPLICATION

8.2.1 The penetrant may be applied by dipping, brushing or spraying. If the penetrant is applied by spraying using compressed air type apparatus, filters shall be placed on the up-stream side near the air inlet to preclude contamination of the penetrant by oil, water, dirt, or sediment that may have collected in the lines.

8.2.2 Penetration time is critical. The minimum penetration time shall be 5 minutes, or as qualified by demonstration for specific application.

8.3 EXCESS PENETRANT REMOVAL

8.3.1 Water Washable Penetrants

Excess water washable penetrant shall be removed with a water spray. The water pressure shall not exceed 50 psi and the water temperature shall not exceed 110 F.

8.3.2 Post-Emulsifying Penetrants

With post emulsifying penetrants, the emulsifier shall be applied by spraying or dipping. Emulsification time is critical and governed by surface roughness and type of discontinuities sought. It shall not exceed 5 minutes unless other times have been qualified by actual test. After emulsification, the mixture shall be removed by a water washable penetrant.

8.3.3 Solvent Removable Penetrants

Excess solvent removable penetrants shall be removed by wiping with a cloth or absorbent paper, repeating the operation until most traces of penetrant have been removed. The remaining traces shall be removed by lightly wiping the surface with cloth or absorbent paper moistened with solvent remover. To minimize removal of penetrant from discontinuities, care shall be taken to avoid the use of excess solvent remover. Flushing the surface with solvent remover following the application of the penetrant and prior to developing, is prohibited.

8.4 DRYING AFTER EXCESS PENETRANT REMOVAL

8.4.1 For the water-washable or post emulsifying technique, the surface may be dried by blotting with clean materials or by using circulating warm air, provided the temperature of the surface is not raised above 125 F.

8.4.2 For the solvent removable technique, the surfaces may be dried by normal evaporation, blotting, wiping or forced air. A minimum of one (1) minute shall be allowed to ensure that the solvent remover has evaporated prior to application of the developer.

8.5 DEVELOPING

8.5.1 The developer shall be applied as soon as possible after excess penetrant removal and in no case shall the time elapsed before the developer application exceed 30 minutes. Insufficient coating thickness may not draw the penetrant out of discontinuities, conversely, excessive coating thickness may mask indications. Two types of developer, dry or wet, may be used with fluorescent penetrants. With color contrast penetrants, only a wet developer shall be used.

8 5 2 Dry Developer Application

Dry developer shall be applied by a soft brush, hand powder bulb, powder bulb, powder gun, or other means, provided the powder is dusted evenly over the entire surface being examined.

8 5 3 Wet Developer Application

Prior to applying suspension type wet developer to the surface, the developer must be thoroughly agitated to ensure adequate dispersion of suspended particles. Aqueous and non aqueous wet developer shall be applied as follows:

- (a) Aqueous developer may be applied to either a wet or dry surface. It shall be applied by dipping, brushing, spraying, or other means, provided a thin coating is obtained over the entire surface being examined. Drying time may be decreased by using warm air, provided the surface temperature of the part is not raised above 125 °F. Blotting is not permitted.
- (b) Non aqueous developer shall be applied only to a dry surface. It shall be applied by spraying, except where safety or restricted access preclude it. Under such conditions, developer may be applied by brushing. Drying shall be by normal evaporation.

8 6 INTERPRETATION

8 6 1 The true size and type of discontinuities are difficult to evaluate if the penetrant diffuses excessively into the developer. Consequently, the surface shall be closely observed during the application of the developer to monitor the behavior of indications which tend to bleed-out for 7 to 30 minutes. If bleed out does not alter the examination results, longer periods are permitted. If the surface to be examined is large enough to preclude complete examination within the prescribed time, the surface shall be examined in increments.

8 6 2 Color Contrast Penetrants

With a color contrast penetrant, the developer forms a reasonably uniform white coating. Surface discontinuities are indicated by bleed out of the penetrant which is normally a deep red color that stains the developer. Indications with a light pink color may indicate excessive cleaning. Inadequate cleaning may leave an excessive background, making interpretation difficult. Adequate illumination is required to ensure adequate sensitivity during the examination and evaluation of indications.

8 6 3 Fluorescent Penetrants

With fluorescent penetrants, the process is essentially the same as in Paragraph 8 6 2 except that the examination is conducted using an ultraviolet light, called "black light". The examination shall be performed as follows:

- (a) It shall be performed in a darkened area.
- (b) The examiner shall be in the darkened area for at least 5 minutes prior to performing the examination to enable his eyes to adapt to dark viewing. If the examiner wears glasses or lenses, they shall not be photo sensitive.
- (c) The black light intensity shall be measured with a black light meter. *The measurement to be taken just prior to inspection and a minimum of 5 minutes after turning on to allow warmup.*

- (d) The black light intensity shall be measured with a black light meter. A minimum of 1000 MH/cm on the surface of the part being examined is required. The black light intensity shall be measured at least once every 8 hours and whenever the work station is changed.

8 7 POST CLEANING

- 8 7 1 After the examination has been completed, the entire examination surface shall be thoroughly cleaned. The method employed shall conform to those specified in Paragraph 7 3.

- 8 7 2 The cleaning agents may now be applied directly to the examination surface.

- 8 7 3 All traces of penetrant materials are to be completely removed.

9 0 EVALUATION OF INDICATIONS

- 9 1 Indications shall be evaluated in accordance with the acceptance standard specified by the governing Code (see Section 12 0, Code Addenda and Acceptance Criteria).

- 9 2 Discontinuities at the surface will be indicated by bleed out of penetrant, however localized surface irregularities due to machining marks or other surface conditions, may produce false or non relevant indications.

- 9 3 Non relevant indications and broad areas of fluorescence or pigmentation which could mask indications of discontinuities are unacceptable, and such areas shall be cleaned and reexamined.

- 9 4 Any indication which is believed to be non relevant shall be regarded as a discontinuity and shall be reexamined to verify whether or not an actual discontinuity is present. Surface conditioning may precede the reexamination.

- 9 5 Relevant indications are those which result from actual discontinuities. Linear indications are those indications in which the length is more than three times the width. Rounded indications are circular or elliptical with the length equal to or less than three times the width.

- 9 6 An indication of a discontinuity may be larger than the discontinuity that causes it, however, the size of the indication and not the size of discontinuity is the basis of acceptance or rejection.

10 0 EXAMINATION OF INDICATIONS

- 10 1 Liquid penetrant examinations shall be documented by a written report which details the condition and acceptability of the item being examined.

10 2 Each report shall include when applicable the following information

- (a) Customer and contract number
- (b) Date of examination
- (c) Identification number for part being examined
- (d) NDE procedure number/revision
- (e) Examination standards
- (f) Acceptance/rejection criteria
- (g) Type of material to be examined
- (h) Surface condition
- (i) Type of penetrant used
- (j) Type of developer used
- (k) Examination results
- (l) Technician's name and certification level

10 3 When applicable, use the liquid penetrant examination report form exhibited in this procedure

11 0 QUALIFICATION OF TECHNIQUES FOR NONSTANDARD TEMPERATURES

11 1 When it is not practical to conduct a liquid penetrant examination within the temperature range of 60 F to 125 F the examination technique at the proposed temperature shall require qualification. This shall require the use of a quench cracked aluminum block, which in this procedure is designated as "liquid penetrant comparator."

11 2 Liquid Penetrant Comparator
ASME Section V, I-653 describes the liquid penetrant comparator to be utilized quality nonstandard temperature techniques. Figure 1 illustrates the comparator after the grooves, if used, are cut.

11 3 Comparator Applications

11 3 1 If it is desired to qualify a liquid penetrant examination technique at a temperature of less than 60 F, the proposed technique shall be applied to block "B" after the block and all materials have been cooled to the proposed examination temperature until the comparison is completed. Block "A" shall be examined in a manner which has previously been demonstrated as suitable for use in the temperature range of 60 F and 125 F. The indications of cracks shall be compared between blocks "A" and "B". If the indications obtained under the proposed conditions are essentially the same as obtained during examination of 60 F to 125 F the proposed technique shall be considered qualified for use.

11 3 2 If the proposed temperature for the examination is above 125 F, block "B" shall be held at this temperature throughout the examination. The indications of cracks shall be compared as described in 11 3 1 while block "B" is at the proposed temperature range.

11 3 3 A procedure qualified at a temperature lower than 60 F shall be qualified from that temperature to 60 F.

11 3 4 To qualify a procedure for temperatures above 125 F the upper and lower temperature limits shall be established and the procedure qualified at these temperatures.

11.3.5 As an alternate to the requirements of paragraphs 11.3.1 and 11.3.2 when using color-contrast penetrants, it is permissible to use a single comparator block for the standard and nonstandard temperatures and to make the comparison by photography.

- (a) When the single comparator block and photographic technique is used, the same processing details as described in Paragraphs 11.3.1 and 11.3.2 apply. The block shall be thoroughly cleaned between the two processing steps. Photographs shall be taken after processing at the nonstandard temperature and then after processing at the standard temperature. The indication of cracks shall be compared between the two photographs. The same criteria for qualification specified in Paragraph 11.3.1 shall apply.
- (b) The identical photographic technique shall be used to make the comparison photographs.

12.0 CODE ADDENDA AND ACCEPTANCE CRITERIA

12.1 The attachments listed below provide additional procedural requirements and applicable acceptance criteria as specified by governing Codes for the performances and evaluation of liquid penetrant examinations. The various attachments reflect mandatory criteria which supersede or supplement this procedure.

- (a) Attachment 1: ANSI Power Piping Code B31.1
- (b) Attachment 2: ASME Section VIII
- (c) Attachment 3: AWS D1.1
- (d) Attachment 4: ASME/ANSI B31.3
- (e) Attachment 5: ASME Section III NF

ATTACHMENT #1

ACCEPTANCE CRITERIA

ANSI B31.1

A1 ACCEPTANCE STANDARDS

Indications whose major dimensions are greater than 1/16 in (2.0 mm) shall be considered relevant. The following relevant indications are unacceptable:

- (a) Any cracks or line indications**
- (b) Rounded indications with dimensions greater than 3/16 in (5.0 mm),**
- (c) Four or more rounded indications in a line separated by 1/16 in (2.0 mm) or less edge to edge**
- (d) Ten or more rounded indications in any 6 sq in (3870 mm²)**

ATTACHMENT # 2

ACCEPTANCE CRITERIA

ASME SECTION VIII

A2 ACCEPTANCE CRITERIA

All surfaces to be examined shall be free of

- (a) Relevant linear indications**
- (b) Relevant rounded indications greater than 3/16 inch**
- (c) Four or more relevant rounded indications in a line separated by 1/16 inch or less (edge to edge)**

ATTACHMENT # 3

ACCEPTANCE CRITERIA

AWS D1.1

A3 ACCEPTANCE CRITERIA

A3.1 SECTION 8 STATICALLY LOADED STRUCTURES

Welds evaluated using liquid penetrant examination method shall be acceptable, if it shows that

- (a) The weld has no cracks
- (b) Thorough fusion exists between adjacent layers of weld metal and ~~base~~ metal
- (c) The sum of diameters of piping porosity in fillet welds does not exceed 3/8 inch in any linear inch of weld and shall not exceed 3/4 inch in any 12 inch length of weld
- (d) Complete joint penetration groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds piping porosity shall not exceed 3/8 inch in any linear inch of weld and shall not exceed 3/4 inch in any 12 inch length of weld

A3.2 SECTION 9 DYNAMICALLY LOADED STRUCTURES

Welds evaluated using liquid penetrant examination method shall be acceptable if it shows that

- (a) The weld has no cracks
- (b) Thorough fusion exists between adjacent layer of weld metal and between weld metal and base metal
- (c) The frequency of piping porosity in fillet welds shall not exceed one in each 4 inch of length and the maximum diameter shall not exceed 3/32 inch. Exception: For fillet welds connection stiffeners to web the sum of the diameters of piping porosity shall not exceed 3/8 inch in any linear inch of weld and shall not exceed 3/4 inch in any 12 inch length of weld
- (d) Complete joint penetration groove welds in butt joints transverse to the direction of computed tensile stress shall have no piping porosity shall not exceed one in 4 inch of length and the maximum diameter shall not exceed 3/32 inch

ATTACHMENT # 4

ACCEPTANCE CRITERIA

ANSI B31.3

- A4 ACCEPTANCE CRITERIA**
All surface examined shall be free of cracks

Attachment #5

ACCEPTANCE CRITERIA

ASME III NF

5A ACCEPTANCE STANDARDS

Indications whose major dimensions are greater than 1/16 in (2.0 mm) shall be considered relevant. The following relevant indications are unacceptable:

- (a) Any cracks or linear indications*
- (b) Rounded indications with dimensions greater than 3/16 in (5.0 mm)*
- (c) Four or more rounded indications in a line separated by 1/16 in (2.0 mm) or less edge to edge*
- (d) Ten or more rounded indications in any 6 sq in (3870 mm)*

FIGURE #1

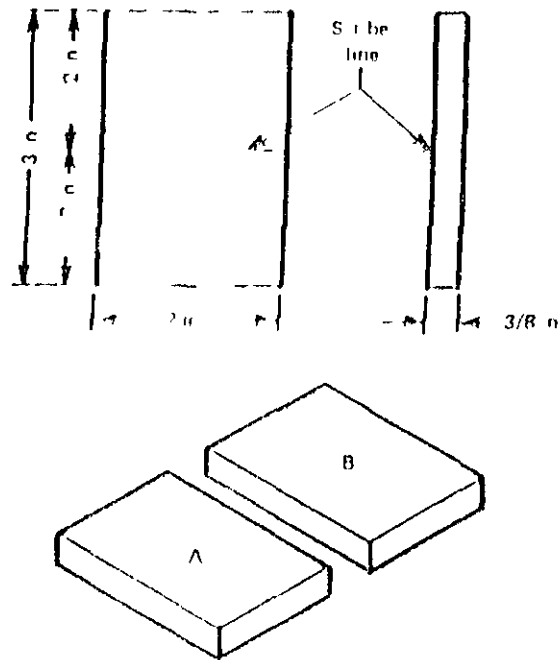


FIG 1 6532 LIQUID PENETRANT COMPARATOR
(NOTE: Dimensions given are for guidance only
and are not critical)

NDE 03 Rev 2
Dated 11-26-96

Inspection Service, Inc NDE Personnel Certification Record														
Test Method & Level	Name & S/S	Certification Period												
Liquid Penetrant II	Sam Wellenbrock	2 17 97 to 2 16-00 541-42 1129												
I Education <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>A. Highest grade attained 12</p> <p>B College level degree earned No</p> <p>C Summary of additional N/A</p> </div> <div style="width: 50%;"> <p>Diploma/ GED earned <input checked="" type="checkbox"/> N</p> <p>Major N/A</p> </div> </div>														
II Related Experience <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>A. Employer Inspection Service Inc</p> <p>Experience Summary See Resume</p> </div> <div style="width: 50%;"> <p>10/1988 to Present</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div style="width: 45%;"> <p>B Employer J A Jones / Kaiser Eng</p> <p>Experience Summary See Resume</p> </div> <div style="width: 50%;"> <p>10/1982 to 10/1988</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div style="width: 45%;"> <p>C Employer J A Jones</p> <p>Experience Summary See Resume</p> </div> <div style="width: 50%;"> <p>9/1973 to 1/1978</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div style="width: 45%;"> <p>D Employer N/A</p> <p>Experience Summary</p> </div> <div style="width: 50%;"></div> </div>														
III Indoctrination/Training <div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>A General Indoctrination</p> <p>B Required Training</p> </div> <div style="width: 35%;"> <p><input checked="" type="checkbox"/> N</p> <p><input checked="" type="checkbox"/> N</p> </div> </div>														
IV Test Results <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">A Type</th> <th style="width: 30%;">Grade</th> <th style="width: 40%;"></th> </tr> </thead> <tbody> <tr> <td>1 General</td> <td>76.7</td> <td rowspan="4" style="vertical-align: top;"> V Eye Exam results acceptable to SNTC-TC-1A/AWS <input checked="" type="checkbox"/> N </td> </tr> <tr> <td>2 Specific</td> <td>93.0</td> </tr> <tr> <td>3 Practical</td> <td>90.0</td> </tr> <tr> <td>4 Composite</td> <td>86.2</td> </tr> </tbody> </table>			A Type	Grade		1 General	76.7	V Eye Exam results acceptable to SNTC-TC-1A/AWS <input checked="" type="checkbox"/> N	2 Specific	93.0	3 Practical	90.0	4 Composite	86.2
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3 Practical	90.0													
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<div style="display: flex; justify-content: space-between;"> <div style="width: 35%;"> <p>NDE Level III or Owner</p> <p></p> </div> <div style="width: 30%;"> <p>Date 9/28/92</p> </div> <div style="width: 30%;"> <p>NDE Assignment Date 6/90</p> </div> </div>														

Appendix H

Material Certifications, Test Log, and Drawing

**Precision Rolled Products, Inc**

PO BOX 60010
14255 MT. BISMARCK
RENO NV 89506
(702) 972-0272
FAX (702) 972-4368

P23956 1B

PAGE 1 OF 2

Customer Order No	Order Date	Ship Date	Shop Order	Alloy
38508 1 #5	03/03/98	04/14/98	P23956-1B	718

Specification(s) AMS 5662K G.E. B50TF15D-S26, G.E. B50T69A-S6 A1 ASTM-B-637-93a
ASME-SB 637 93a, SPS-M 275K, CAPABLE OF AMS 5663J, RBO-170-153G*,
CHEMISTRY OF G.E. C50TF13-S16 and HI SHEAR #156 8/13/86**

Quantity (Pcs /Wt)	1 BDL / 3919 LBS	Size or Dwg Number	750" RD X 11' - 13' R/L
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Heat Number E4881

Melt Method VIM/ESR

Chemical Analysis Remelt Ingot

Raw Material Source: Latrobe Steel/PRP-SAMD

C	Mn	Si	P	S	Cr	Ni	Co	Mo	Nb + Ta	Ti
0 026	0 21	0 08	< 010	0 002	18 46	53 76	0 48	3 09	5 46	0 94
Al	B	Ta	Cu	Fe	Ca	Mg	Pb	Bi	Se	Nb
0 50	0 003	0 010	0 04	16 85	< 0 010	< 010	< 0001	00001	< 0001	5 45

Chemistry Source PRP/SAMD T5985 Trace element analysis performed by Dickson Testing Co T2981

MILL THERMAL TREATMENT (AS SHIPPED CONDITION)

M) 1750F 1 hour, water quench and centerless ground

Grain size ASTM No 10 0 Micro No W1236U PRP Etchant No 4, (100X)

Hardness 262 HB

Grain size determined in accordance with ASTM-E 112-88 and G.E. E50TF133-S9
Microstructure conforms to requirements specified in the referenced specifications

*Material is capable of RBO 170-153 specification, testing was not performed

**HI SHEAR SPEC #156 Except paragraph 6 2 material ESR melted not VAR melted

Material is free of mercury contamination

S#20170

CAPABILITY TESTING**CAPABILITY THERMAL TREATMENT**

A) Precipitation heat treat 1325F 8 hours, furnace cool to 1150F (100F/hour)

hold 8 hours air cool

Hardness 415 HB

Mechanical and Metallurgical Tests

Cnd	Temp (F)	UTS (ksi)	YS (2x) (ksi)	Stress (ksi)	Life (Hrs)	KE1	XR A
A	RT	217 0	176 0			19 5	40 9
A	1200	170 0	145 0			27 0	72 3
A	1200			110 0	26 0	28 3	

Rupture specimen type combination notch and smooth

Notch Diameter 0 1775" Notch Radius 0 0050"

**Precision Rolled Products, Inc**

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RENO, NV 89508
(702) 972-0272
FAX (702) 972-4368

PAGE 2 OF 2

Customer Order No	Order Date	Ship Date	Shop Order	Alloy
38508 1 #5	03/03/98	04/14/98	P23956-1B	718

Heat Number: E4881

CAPABILITY THERMAL TREATMENT

B) Resolution treat 1750F 1 hour water quench
Precipitation heat treat 1325F 8 hours, furnace cool to 1150F (100F/hour)
hold 8 hours, air cool
Hardness 415 HB
Grain size ASTM No 10 0 Micro No W1237U PRP Etchant No 4 (100X)

Mechanical and Metallurgical Tests

Cond	Temp (F)	UTS (ksi)	YS (2k) (ksi)	Stress (ksi)	Life (Hrs)	%EL	%R A
B	RT	217 0	176 0			20 0	39 9
B	1200	171 0	144 0			24 9	60 9
B	1200			100 0	40 0	38 2	

Rupture specimen type combination notch and smooth
Notch Diameter 1780 Notch Radius 0050"

Tensile and Stress Rupture test specimens were machined and tested by
Dickson Testing Co T2981

Hardness, metallography and capability thermal treatment were performed by PRP/Reno T5978

Joseph Brooke 4-14-98
Joseph Brooke / Lab - Testing Supervisor

The test results shown above are certified to be true and in accordance with specification requirements and records maintained in our files

**APPROPRIATE & CORROSION INFORMATION**

Cert. that this is a true copy of the certificate of
Test and on Material used to fill your order

Signed *Jude Pietrzykowski*

Customer *25 + m machine*

PO # *008972*

QTY *3/4" x 12' R/L* Quantity *1pc cut in half*

Shipped *4/12/99* Invoice # *7911*



15651 S E 125th Court • Clackamas Oregon 97015
 Phone (503) 656-3203 • Fax (503) 655-6898

CUSTOMER GEORGE MACH DATE 4-29-98

PO # 2856 Brinell 429-444
 Description Pins
 Quantity 9
 Material Type AKA 718 Case Depth 6"

By: [Signature]

ACTION Item EKS obtain Post-Test Cal
on gauge AFTER test and Prior
to Report

ACTION Item EKS include NDE Procedure
: Qualification w/ Report

ACTION Item EKS include Results of Brinell
Hardness w/ Test Report

Grapple Body H-1-82864-010-001 - Wire Retention
used for Test

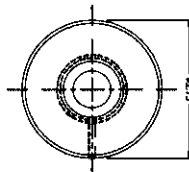
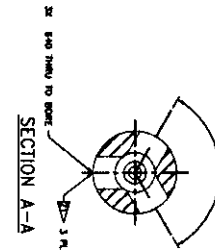
Adapter Coupling # 004

Dial Indicator verified using .150 Jo-Block
by Eric Stralsund & Doug Chenzult

2 ACTUATOR/COUPLING SUBASSY
SCALE /

8 ACTUATOR COUPLING
SCALE /

6 GRAPPLE BODY
SCALE /



9 GRAPPLE BODY COUPLING
SCALE /

7 ACTUATOR SHAFT
SCALE /

FOR GENERAL NOTES AND PARTS
LIST SEE SHEET 1

9 SCALE /

GRAPPLE BODY COUPLING

REV. NUMBER _____

TITLE _____

REVISIONS _____

DATE USED ON _____

REV.	DATE	DESCRIPTION	BY	CHKD
1	06-25-78	ISSUED		

CHANGED FROM _____

REVISIONS _____

DATE _____

ISSUED _____

BY _____

CHKD _____

PLANT SCALE /

SCALE /