TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

June 20, 1985

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

During an NRC inspection by H. Phillips at Watts Bar Nuclear Plant on May 3, 1985, TVA committed to document our findings on unmarked bolts on vendor supplied, skid mounted pumps, the vital battery racks, 480V reactor MOV boards and the safety injection pump 1B-B top vent flange. Enclosed is an internal TVA memorandum with attachments which documents our findings.

If you have any questions concerning this matter, please get in touch with R. H. Shell of may staff at FTS 858-2688.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

J. A. Domer

J. A. Domer, Chief
Nuclear Licensing Branch

Sworn to and subscribed before me
this 20th day of June 1985

Bryant M. Lowery
Notary Public
My Commission Expires 4/8/86

Enclosure
cc: U.S. Nuclear Regulatory Commission (Enclosure)
Region II
Attn: Dr. J. Nelson Grace, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Encl To: Reg File
NRC PDR
LPDR
NSIC
24 X
Tom Kenyon

B001
1/2

Dist
Per Pm

8506240346 850620
PDR ADOCK 05000390
A PDR

50-390

INTERNAL T.V.A. MEMORANDA WICH DOCUMENTS FINDINGS ON UNMARKED BOLTS ON VENDOR SUPPLIED, SKID MOUNTED PUMPS ETC....

Doc. # 50-390
Control # 8506240346
Date 6/20/85 of Document
REGULATORY DOCKET FILE

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RECORDS FACILITY BRANCH

UNITED STATES GOVERNMENT

Memorandum

CRC

TENNESSEE VALLEY AUTHORITY

B45 '85 0611 251

TO : D. W. Wilson, Site Design Services Manager, Watts Bar Nuclear Plant, NUC PR

FROM : J. C. Standifer, Project Manager, Watts Bar Engineering Project, P-104 SB-K

DATE : JUN 11 1985

SUBJECT: WATTS BAR NUCLEAR PLANT - U.S. NUCLEAR REGULATORY COMMISSION (NRC) INVESTIGATION FROM APRIL 29 THROUGH MAY 3, 1985, REGARDING CONTROL OF SMALL BOLTING

Please refer to the exit meeting between Henry Phillips of the NRC and TVA personnel (R. M. Jessee, E. A. Merrick, and P. V. Guthrie) at Watts Bar on May 3, 1985.

During the exit meeting, TVA committed to documenting our findings on the unmarked bolts found on vendor-supplied skid-mounted pumps, the vital lead acid storage battery racks, the 480V Reactor MOV Boards, and the Top Pump Vent Flange installed by TVA on Safety Injection System 1B-B. A documentation search was performed to determine the bolting material specified for the applications in question. Independently, an in-situ hardness test was performed on the unmarked bolts installed on vendor-supplied skid-mounted pumps and the vital lead acid storage battery racks to determine the hardness range of the bolts. The hardness range obtained was used as a method of verifying that the specified material was installed as documented.

The eight components in question are listed as follows:

1. Containment Spray Pump - Manufactured by Babcock and Wilcox (B&W) and purchased through the NSSS contractor, Westinghouse.

2. Component Cooling Water Pump - Manufactured by Delaval and purchased by TVA.

3. Residual Heat Removal Pump - Manufactured by Ingersoll-Rand and purchased through the NSSS contractor, Westinghouse.

4. Centrifugal Charging Pump - Manufactured by Pacific Pump and purchased through the NSSS contractor, Westinghouse.

5. Positive Displacement Pump - Manufactured by Union Pump Company and purchased through the NSSS contractor, Westinghouse.

6. Vital Lead Acid Storage Battery Racks - Manufactured by GNB Batteries, Incorporated, and purchased by TVA.

7. 480V Reactor MOV Boards - Manufactured by ITE Imperial and purchased by TVA.

8. Top Pump Vent Flange Bolts installed by TVA on Safety Injection System Pump 1B-B.

E15161.01

SENT JUN 11 1985

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

D. W. Wilson

JUN 11 1985

WATTS BAR NUCLEAR PLANT - U.S. NUCLEAR REGULATORY COMMISSION (NRC) INVESTIGATION FROM APRIL 29 THROUGH MAY 3, 1985, REGARDING CONTROL OF SMALL BOLTING

TVA requested Westinghouse to provide documentation on specified materials, a description of the Westinghouse procedure to assure control of unmarked bolting (both by Westinghouse and the subvendor) to the point of installation in the component, and justification regarding why other Westinghouse-supplied equipment should not be inspected at Watts Bar on the pumps they supplied (see attachment 1 for a copy of the letter from John A. Raulston to E. A. Novotnak dated May 14, 1985, B45 850514 112). In response to TVA's request, Westinghouse transmitted letter WAT-D-6583 dated June 3, 1985 (attachment 2). WAT-D-6583 references Westinghouse letter WAT-D-5777 dated November 14, 1983 (attachment 3), which provided information on bolting material and torquing requirements for the centrifugal charging, safety injection, residual heat removal, and spent fuel pit cooling pumps and promised information on the containment spray pump at a later date. Letter WAT-D-6583 identifies an error on the incorrect labeling of Table IV in letter WAT-D-5777 and transmits information on the containment spray pump as originally promised.

TVA requested the manufacturers of the components we purchased directly to supply documentation or certification of the required bolting material. Attachment 4 is a copy of the documentation sent by Delaval stating the suspect bolting material for the component cooling water pump should be either ASTM A449 or ASTM A325, Type I. Attachment 5 is a copy of the documentation sent by GNB Batteries, Incorporated, stating the suspect bolting material for the vital lead acid storage battery racks should be ASTM A307 or equivalent. Attachment 6 is a copy of documentation sent by ITE Imperial stating the suspect bolting material for the 480V reactor MOV boards should be ASTM A307.

In-situ hardness testing, in accordance with attachment 7, was performed on the vendor-supplied pumps and vital lead acid storage battery racks containing bolts that were unmarked:

1. The containment spray pump suspect bolts were cleaned during preparation for hardness testing and found to be marked with three radial lines indicating ASTM A449 or SAE Grade 5. Documentation received from Westinghouse in attachment 2 indicates the bolting material should be ASTM A193 Gr. B7. TVA has generated NCR WBNNEB8510 to cover this nonconformance and is currently working with Westinghouse to determine the cause and disposition of the NCR.

D. W. Wilson

JUN 11 1985

WATTS BAR NUCLEAR PLANT - U.S. NUCLEAR REGULATORY COMMISSION (NRC) INVESTIGATION FROM APRIL 29 THROUGH MAY 3, 1985, REGARDING CONTROL OF SMALL BOLTING

2. The component cooling water pump suspect bolts were cleaned during preparation for hardness testing and found to be marked with three radial lines. This marking indicates ASTM A449 or SAE Grade 5 material which corresponds to the certification supplied by Delaval in attachment 4.

3. Four of the eight motor-hold-down bolts for each unit of the residual heat removal pumps (1AA and 1BB) were hardness tested in accordance with attachment 7. Leeb values converted to Brinell yielded hardness values ranging from 177 to 211 Brinell for the eight bolts tested. These values all fall within the hardness requirements for ASTM A307 Grade B bolts (121-212 Brinell). Attachment 8 gives the raw hardness data taken during testing of these eight bolts. The hardness test results correspond to the material documentation supplied by Westinghouse in Table III of attachment 3.

4. Three speed-reducer bolts and five motor-hold-down bolts were evaluated for the two centrifugal charging pumps. The observed hardness range suggested the bolts were of ASTM A325 for the size range 1/2"-1" (248 to 331 Brinell), although four of the bolts, speed-reducer NE Bolt 1 and motor-hold-down bolts NE Bolt 1, NW Bolt 1, and SE Bolt 3, exhibited hardness values below the required range. It was felt that additional surface preparation to remove any decarburization would produce satisfactory results. Two of the lower hardness bolts, speed-reducer NE Bolt 1 and motor-hold-down NE Bolt 1, were retested after receiving additional surface preparation and satisfactory results were recorded. Attachment 9 gives the raw hardness data taken during testing of the bolts (as noted on the attachment, the speed reducer NE Bolt 1 and motor-hold-down NE Bolt 1 are reported utilizing the retested values). Failure of the battery-powered grinding equipment prevented further evaluation of the two remaining lower hardness bolts during the retesting operation. The hardness test results correspond to the material documentation supplied by Westinghouse in Table I of attachment 3.

D. W. Wilson

JUN 11 1985

WATTS BAR NUCLEAR PLANT - U.S. NUCLEAR REGULATORY COMMISSION (NRC) INVESTIGATION FROM APRIL 29 THROUGH MAY 3, 1985, REGARDING CONTROL OF SMALL BOLTING

5. Two of the four motor-hold-down bolts on the positive displacement pump were evaluated and yielded Leeb values of 552 and 567 LD units. These values converted to Rockwell values of C27 and C29, respectively (273 to 289 Brinell). Ultimate strength correlations yield 133,000 and 142,000 lb/in^2 respectively, indicating these bolts are within the strength requirements of ASTM A193 Grade B7 bolts. While hardness is not a requirement of ASTM A193 Grade B7, extensive evaluation at Singleton Materials Engineering Laboratory has indicated the typical range to be 27 to 33 HRC. Attachment 10 gives the raw hardness data taken during testing. TVA reviewed Westinghouse Equipment Specification G-952320 (attachment 11) on the positive displacement pumps and determined the hardness test results correspond to the material documentation listed in the attachment.

6. Hardness measurements were made on 15 bolts in each vital lead acid storage battery rack room. The converted hardness values of the 30 bolts ranged from 193 to 239 Brinell. All values fall within the hardness limits of ASTM A307 Grade A (121 to 241 Brinell). These results correspond to the specified material listed in attachment 5. Attachment 12 gives the raw hardness data taken during testing.

7. The 480V Reactor MOV Boards 1-MCC-213-B1B and B2B, 1-MCC-232-1B-B, and annunciator system cabinets that contained unmarked, 5/16-inch diameter bolts were determined to be installed by TVA. The vendor, ITE Imperial, verified by transmittal of attachment 6 that the bolting material should be ASTM A307 and 5/16-inch diameter. The ASTM A307 bolting material without identification marking on the head has been documented as acceptable by NCRs WBN 1602 and WBN 3372.

8. The 3/4-inch diameter vent flange bolts and nuts were inspected and found to be marked inconsistently with drawing requirements. An investigation is being conducted by NUC PR mechanical maintenance personnel, but to date, an NCR has not been identified. The questionable bolts were removed by WBNP mechanical maintenance personnel under MR 526555 and were replaced with material consistent with drawing requirements.

D. W. Wilson

JUN 11 1985

WATTS BAR NUCLEAR PLANT - U.S. NUCLEAR REGULATORY COMMISSION (NRC) INVESTIGATION FROM APRIL 29 THROUGH MAY 3, 1985, REGARDING CONTROL OF SMALL BOLTING

Attachment 13 provides a tabular summary of the investigation results of the unmarked bolting for the eight components in question.

Attachment 14 gives TVA's position on the control of small diameter bolting from vendors on a generic basis for Watts Bar Nuclear Plant.

If you have any questions, please contact E. A. Merrick or C. R. Cantrell at extension 7906.

Original Signed By
J.C. Standifer

J. C. Standifer

JAR:CRC:TU
Attachments
cc (Attachment):
RIMS, SL26 C-K
R. M. Pierce, 9-169 SB-K
*John A. Raulston, W10C126 C-K--Attn: D. L. Williams

*Please handle according to appropriate procedures established for dealing with the investigation. H. Phillips (U.S. NRC) was promised a copy of the results of our evaluation.

Principally prepared by C. R. Cantrell, extension 7906.

E15161.01

TENNESSEE VALLEY AUTHORITY
KNOXVILLE, TENNESSEE 37902

400 West Summit Hill Drive, W10C126

ATTACHMENT 1

MAY 14 1985

B45 '850514 112

Westinghouse Electric Corporation
Post Office Box 355
Pittsburgh, Pennsylvania 15230

Attention: Mr. E. A. Novotnak

Gentlemen:

WATTS BAR NUCLEAR PLANT
NUCLEAR STEAM SUPPLY SYSTEMS
CONTRACT 71C62-54114-1
LETTER NO. W-5999

BOLTING MATERIAL FOR VARIOUS PUMPS (205-30) - N3M-2-50

We acknowledge receipt of your letter No. WAT-D-6538 (B45 850508 601).

As discussed with your A. N. MacCrum and our E. A. Merrick and C. R. Cantrell in Knoxville on May 7, 1985, the NRC investigation at Watts Bar uncovered a possible programatic concern regarding the manner in which Westinghouse sub-vendors control their small diameter bolting to the point of installation. The NRC inspector identified several components which contained unmarked bolts delivered to the site on skid-mounted assemblies which require clarification.

Previous conversations between Mr. MacCrum (Westinghouse) and P. G. Ioannides (TVA) on this subject resulted in your response via the referenced letter. While your response presents a broad brush answer to the questions raised, we question your statement that small bolts do not require markings, and furthermore, we need additional information concerning details of your program. Identified on the enclosure are four bolting applications which require positive clarification by Westinghouse. Your response should include the following:

1. The bolting material specified for the applications of concern, along with those Westinghouse and sub-contractor drawings or specifications which implement the requirements.

2. A description of the Westinghouse procedure to assure control of unmarked bolting both by Westinghouse and the sub-vendors to the point of installation in the component. One of our concerns is what action should TVA take when one of these unmarked bolting materials require replacement. What replacement bolting material should be used?

E65129.09

Westinghouse Electric Corporation

3. Westinghouse should, in addition, provide TVA with justification regarding why other Westinghouse supplied equipment should not be inspected to determine if there are other applications in question at WBN.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

Pam G. Tarwinder

for John A. Raulston
Chief Nuclear Engineer

cc: Westinghouse Electric Corporation
Attention: Mr. J. L. Larkin

Westinghouse Electric Corporation
Attention: Mr. G. W. Yetter

E65129.09

Enclosure 1

Example Bolting Application to be Investigated

Item 1 - Containment Spray Pump (B&W)
Drawing 71-500-149
Bolts are marked with

Bolts in question identified on item 1 drawing.

Item 2 - RHR Pump - Motor to pump bolts
Drawing C-8X20WDF500 X 9 -C

Bolts in question identified on item 2 drawing.

Item 3 - Centrifugal Changing Pump (Pacific Pump)
Drawing FC-48590

Bolts in question identified on item 3 drawing.

Item 4 - CVCS Pump (Union Pump Co.)
Drawing P-EN742885 A&B

Bolts in question identified on item 4 drawing.

E65129.09

cc: RIMS, SL26 C-K
Williams, R. G., 650B CUBB-C
Wadewitz, Guenter, Watts Bar Nuclear OC (3)
Standifer, J. C., P-104 SB-K
Pierce, R. M., 104 ESTA-K
Sanders, J. E., W10C148 C-K
Parris, J. L., 116 ESTA-K (2)
Darling, J. P., 1750 CST2- C
Weir, R. C., W10B120 C-K

Ltr No. W-5999 AR
Other I.D. 54114-1 to Westinghouse

E65129.09

DISTRIBUTION CONTROL
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MB

ATTACHMENT 2

TELECOPI

WAT-D-6583

Westinghouse Electric Corporation

Water Reactor Divisions

Nuclear Operations Division

Box 355
Pittsburgh Pennsylvania 15230

JUN 07 1985

JAR: JES	DRAFT REPLY	COM. COPY	INFO COPY	DUE DATE
CC:				
EEB				
CEB				
MEB				
NEB-DSG				
NEB-OSG				
NEB-SSG				
NEB-NAL				

June 3, 1985

TVA Contract No. 71C62-54114-1

S.O. No: WAT/WBT-205

Ref: WAT-D-5777

SQUAD CHECKS
- ☐ FULL REVIEW
- ☐ REVIEW OF SPECIFIC ASPECTS
- ☐ NO REVIEW
- ☐ _____

Mr. J. A. Raulston
Chief Nuclear Engineer
TENNESSEE VALLEY AUTHORITY
400 West Summit Hill Drive, W10 C126
Knoxville, TN 37902

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
UNIT NUMBERS 1 and 2
BOLTING MATERIAL FOR VARIOUS PUMPS (205-30)

Dear Mr. Raulston:

Westinghouse letter WAT-D-5777 previously provided the bolt size, the bolt material, the bolt torquing requirements and the bolt torquing sequence for both motor hold down and pump baseplate foundation bolts for the noted pumps. TVA letter W-5152 requested this information.

Westinghouse has recently reviewed this information and the seismic reports for the pumps referred to in the above letters and find this data to be accurate with one exception. The "TABLE IV" information is for the spent fuel pit cooling pump and not for the containment spray pumps. The containment spray pump data is attached to this letter although previously transmitted. We hope this will assist you in answering the NRC questions regarding bolts.

Please also be informed that Westinghouse is still investigating the issue of motor hold down bolts with respect to the seismic design report call out versus the actual material lists used by the suppliers in assembling the pumps. This effort is continuing since in at least one instance (non TVA pump) the motor hold down bolts identified by a suppliers material list and the suppliers design requirements were found to be inconsistent. We will advise you of our findings at a later date.

Answered by Ltr #_____

JUN 85

JAR	
JFC	
RTD	
HRD	
PGI	
CJG	
DJG	
SSG	
GRJ	

8506070603

ADVANCE COPY OF THIS LETTER
SENT TO WEP & RMP

MASTER FILE
RIMS, SL26 C-K

If you have any questions or require further information on the data provided herein, please advise.

Very truly yours,

WESTINGHOUSE ELECTRIC CORPORATION

Edward A. Novotnak

Edward A. Novotnak, Manager
Tennessee Valley Authority Projects

ANM/bdm/5221d:1

cc:	J. A. Raulston	3L, 3A
	J. Larkin	1L
	I. R. Williamson	1L
	R. G. Williams	1L
	J. W. Hufham	1L

Date: 9/6/83
Supersedes: 11/11/80
Dwg. No.:

CONTAINMENT SPRAY PUMP
D321 6/3/85

PUMP COMPANY

ENGINEERING STANDARDS

BOLT TORQUING PROCEDURE

ISSUE	PAGES REVISED	SUPERCEDES	ISSUED BY	APPROVED BY	DATE
01	Initial Issue				6/24/77
02	2	JUNE 1, 1977			5/26/78
03	4	MAY 26, 1978			11/13/80
04	3	Nov. 11, 1980	9/6/83	9/6/83	9/6/83

DISTRIBUTION ★ B

Standard Issued By:

Approved By:

BOLT TORQUING PROCEDURE

1.0 SCOPE

This procedure covers the requirements for Bolt Torquing utilizing torque wrenches. Specific contractural torque values will be included on a drawing in the form of Appendix I.

2.0 TORQUING PROCEDURE (Gasket Joint)

To ensure proper gasket seating the following bolt up procedure must be followed:

1. Install gasket on the gasket seating surface and bring cover flange in contact with gasket (when applicable).
2. Install all fasteners, making sure they are free from dirt and grit.
3. Run up all fasteners finger tight.
4. Develop the required torque in a minimum of three steps, following a tightening procedure as recommended in Figure 1. It is important to make certain that no more than 50% of the required bolt torque is achieved on the initial set. Once a complete cycle of stressing has been achieved, it is not necessary to follow the exact bolting sequence recommended but the general pattern should be followed.

3.0 TORQUING PROCEDURE (O-Ring Joint)

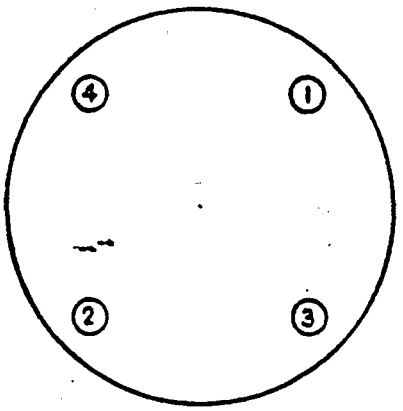
For O-Ring Gasket joints the following bolt up procedure is to be followed:

1. Install all fasteners, making sure they are free from dirt and grit.
2. Run up all fasteners finger tight.
3. Develop the required torque in a minimum of two steps, the exact torquing sequence as shown in Figure 1 need not be followed, but it is recommended that the general sequence be followed.

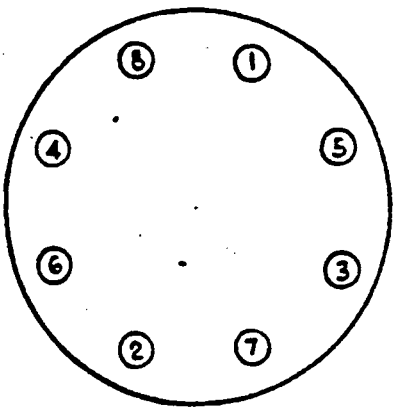
BOLT TORQUING PROCEDURE

FIGURE 1

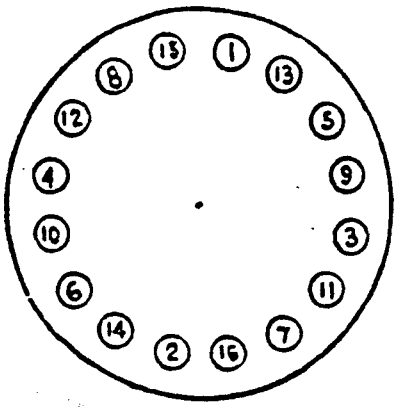
BOLTING-UP SEQUENCE



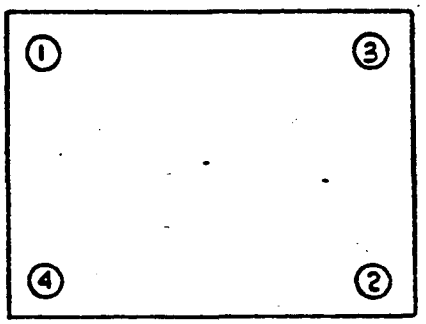
4 BOLT COVER



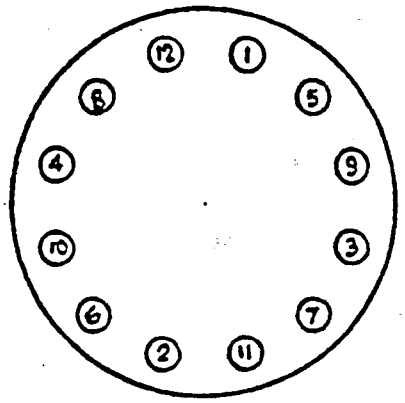
8 BOLT COVER



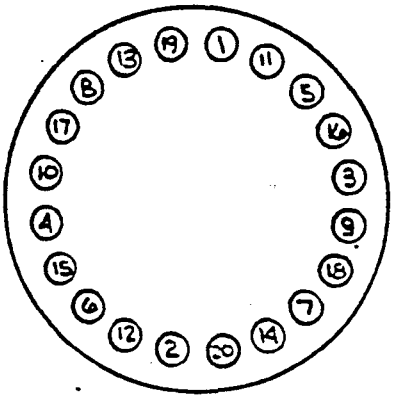
16 BOLT COVER



4 BOLT FEET



12 BOLT COVER



20 BOLT COVER

APPENDIX

DRAWING NO. _____

To be used in conjunction with Eng. Std. 6.0.4/. 1 Rev. ____ dated _____

Contract _____ Pump Type _____

tomer _____

Torque Requirements:

tener t No.	Joint	Torque Required (ft-lbs)
	Motor to Baseplate _____	

SAMPLE

					DRAWN	SUPERSEDES	Hayward Tyler PUMP COMPANY Burlington, Vermont	
					DATE	SUPERSEDED BY	EQUIPM'T. NAME – Torquing Procedure	
					SCALE		PART/ASS'Y.	
					CHK'D.	FIRST ORDER		ASS'Y. REF. No.
					APP'D.	DO NOT SCALE		DWG. No. REV.
DATE	PARTICULARS	REV. BY	CH'D BY	APP'D BY		IF IN DOUBT – ASK!		

APPENDIX — DRAWING NO. 01-009 5

To be used in conjunction with Eng. Std. 6.0.4/2-1 Rev. 04 dated November 6, 1983

Contract 5-0178-55179 Pump Type 10x14x22 NHSH

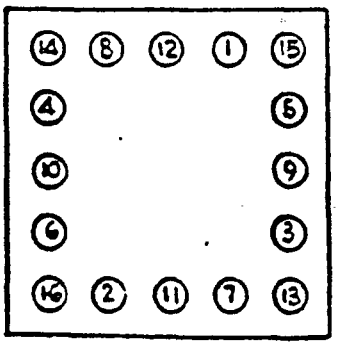
Customer Westinghouse Electric Corporation Service: Containment Spray Pumps

Site: Watts Bar, Units 1 and 2

Torque Requirements:

Fastener No.	Joint (Fastener Size)	Fastener Material	Torque Required (ft-lbs)
03, 1104	Backcover-Casing (1-3/8" - 8 UN)	ASME SA453 Gr 660 ASME SA194 Gr B6	750
42	Outboard Brg. Cvr. - Frame (3/4" - 10 UNC)	ASTM A193 Gr B7	60
26	Inboard Brg. Cvr. - Frame (3/4" - 10 UNC)	ASTM A193 Gr B7	60
27	Frame - Backcover (1" - 8 UNC)	ASTM A193 Gr B7	150
28, 7230	Gland Plate - Backcover (5/8" - 11 UNC)	ASME SA453 Gr 660 ASME SA194 Gr B6	60
62, 5363	Oiler Cooler - Frame (3/4" - 10 UNC)	ASTM A193 Gr B7 ASTM A194 Gr 2H	80
64, 5365	Oiler Cooler Cover - Box (3/4" - 10 UNC)	ASME SA453 Gr 660 ASME SA194 Gr B6	120
231, 239	Pump Casing - Pedestal (1-3/4" - 8 UN)	ASME SA193 Gr B7 ASME SA194 Gr 2H	1350
241, 0244	Pump Pedestal - Baseplate (1-3/4" - 8 UN)	ASME SA193 Gr B7 ASME SA194 Gr 2H	800
332	Frame Support - Frame (1" - 8 UNC)	ASTM A193 Gr B7	150
	Motor to Baseplate (1" - 8 UNC)	ASTM A193 Gr B7	220

Note: In addition to the bolting up sequence as shown in Figure 1 of the above referenced Engineering Standard, the following also applies:



16 Bolt Cooler

DRAWN D. Clare	SUPERSEDES	Howard Tyler Pump Company, Burlington, Vermont	
DATE 11/8/83	SUPERSEDED BY	EQUIPMT. NAME Torquing Procedure	
SCALE —		PART/ASSY. 71-600-186	
CHK'D. 11/21/83	FIRST ORDER 55179	ASSY. REF. No.	
APPD. 11/21/83	DO NOT SCALE	DWG. No. 01-009-995	REV. 0

ATTACHMENT 3

WAT-D-5777

NOV 18 1983

DATE		
S.O.		
TITLE	INFO	ACTION
S.M.		
MECH.		
P & W		
I & C		
ELEC.		
SYS.		
SEC.		

Westinghouse Electric Corporation

Water Reactor Divisions

Nuclear Operations Division

Box 355
Pittsburgh Pennsylvania 15230

November 14, 1983

TVA Contract No. 71C62-54114-1

S.O. No: WAT/WBT-205

Mr. J. A. Raulston
Chief Nuclear Engineer
TENNESSEE VALLEY AUTHORITY
400 Commerce Avenue, W10 C126
Knoxville, TN 37902

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
UNIT NUMBERS 1 and 2
Safety Related Pumo Motor Alignment and Torquing Information (205-27)

Dear Mr. Raulston:

THe following information is submitted in reply to your letter W-5152. This letter requested information on installation and realignment of pump motors.

Pumps

Centrifugal Charing - Table I*
Safety Injection - Table II*
Residual Heat Removal - Table III*
Spent Fuel Pit Cooling - Table IV*
Containment Spray - This date has been requested from the pump supplier and is promised for January 30, 1984.

Boroc Acid - Torque values for the coupling bolts are given in the coupling section of the Instruction Manual. No torqueing sequence is specified but following normal good practice procedures is sufficient. No other bolts are important for motor-pump alignment.

* Tables referenced are attached to this letter.

If there are any further concerns, please contact this Project Office at your convenience.

Very truly yours,

WESTINGHOUSE ELECTRIC CORPORATION

J. L. Tain, Manager
Tennessee Valley Authority Projects

AM/cm/4277D:1

Attachments

cc: J. A. Raulston, 3L, 3A
J. Larkin, 1L
S. A. Moser, 1L
R. G. Williams, 1L
L. M. Mills, 1L

TABLE I

Centrifugal Charging Pumps

Motor Hold Down Bolt Size -- 7/8" 9 NC

Motor Hold Down Bolt Material - ASTM-A-325 (or equivalent)

Motor Hold Down Bolt Torquing Requirement -- 225 feet-lb.

Motor Hold Down Bolt Torquing Sequence -- Bolts should be torqued in an alternating sequence across the unit, first to 50%, then 100% torque value.

Pump Baseplate Foundation Bolt Size -- 1" 8 NC

Pump Baseplate Foundation Bolt Material -- Steel having a minimum Sy of 36 KSI.

Pump Baseplate Foundation Bolt Torque -- 100 feet-lb.

Pump Baseplate Foundation Bolt Torquing Sequence - Bolts should be torqued in an alternating sequence across the unit, first to 50%, then 100% torque value.

TABLE II

Safety Injection Pumps

Motor Hold Down Bolt Size - 3/4" 10 NC

Motor Hold Down Bolt Material - ASTM-A-325 (or equivalent)

Motor Hold Down Bolt Torquing Requirement - 175 feet-lb.

Motor Hold Down Bolt Torquing Sequence -- Bolts should be torqued in an alternating sequence across the unit, first to 50%, then 100% torque value.

Pump Baseplate Foundation Bolt size - 3/4" 10 NC

Pump Baseplate Foundation Bolt Material -- Steel having a minimum Sy of 36 KSI.

Pump Baseplate Foundation Bolt Torque -- 70 feet-lb.

Pump Baseplate Foundation Bolt Torquing Sequence -- Bolts should be torqued in an alternating sequence across the unit, first to 50%, then 100% torque value.

TABLE III

Residual Heat Removal Pumps

Motor Hold Down Bolt Size - 3/4 inch

Motor Hold Down Bolt Material - A307 Grade B

Motor Hold Down Bolt Torquing Req. - 47-55 ft/lb.

Motor Hold Down Bolt Torquing Sequence - Alternating sequence across the unit, first to 33%, then 67%, then 100% torque value.

Pump Baseplate Foundation Bolt Size - 2.0 inch - 8N

Pump Baseplate Foundation Bolt Material - A-193 Grade B7 or equal

Pump Baseplate Foundation Bolt Torque - 240 to 250 ft/lb.

Pump Baseplate Foundation Bolt Torque Seq. - Proceed circumferentially around unit. First to 33%, then 67%, then 100% torque value.

TABLE IV

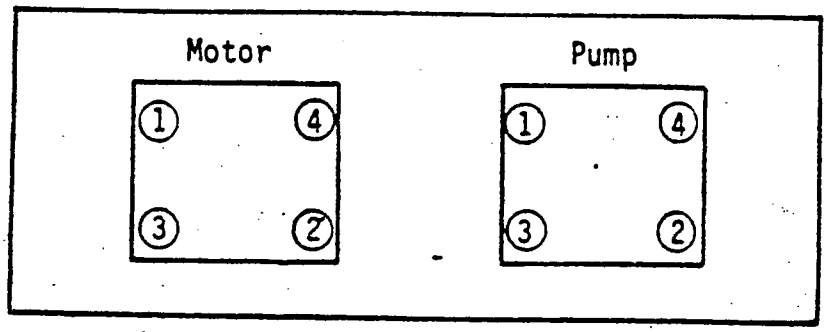
Containment Spray Pump

September 19, 1983

Pump and Motor Holddown Bolts

	Material	Size (Inch)	Torque (Ft-lbs)
Pump Holddown Bolts	A 540B21 C11	1.0	1060
Motor Holddown Bolts	A 307	0.625	59

Torque Sequence



W P.O. No. 171761
S/N N229B729

MAY 8 1 ...

85. 05/08 10:59 P01 *4042 TDI ATLANTA EP/DC

Transamerica Delaval

To: OPERATOR Date: MAY 8, 1985

From: A. T. OLSSON, Atlanta District Office, (Telecopy No: 404-266-9969

Subject: (If not given on the following page)

TVA - WATTS BAR NUCLEAR PLANT
COMPONENT COOLING WATER PUMPS 76K31-83173
DELAVAL REF.: S.O. 707573-7
PUMP & MOTOR HOLD-DOWN BOLTS

1. Number of pages attached to this cover sheet THREE

2. Please forward to the addressee at your location shown on the next page or to:

MR. FRANK CARR (PHONE: 632-6378)

3. Please make photocopies for any others shown for your location and deliver.

4. If you have any questions regarding this transmittal, please contact the following verifying number: 404-261-7063.

5. Thank you.

(Per telephone conversation)

Ted Olsson

HANDWRITTEN ☐ PARTS LIST & ESTIMATE SHEET ☒ ROUGH BILL OF MATERIAL ☐ ALTERATION

☐ CARDS ☐ NO CARDS | R/E | ORDER NO. 707573 | PRODUCT CODE 5310 | S/M 414 | CUSTOMER TVA WATTS BAR NUC. P. | ROTATION CW | TYPE P

COST ANALYSIS DATA | OUTLINE | ASSEMBLY | ISSUED | COMPLETE | SHEET 12

MAT'L COST	LABOR COST	BURDEN COST	HOURS	LINE	F.O.P.	TOTAL QTY.	CL	SYMBOL DESCRIPTION	HDW. CODE	HARDWARE DESCRIPTION SYMBOL	MATERIAL CODE	MATERIAL DATA
				1				FOR SERIAL	NO 707578-7			
				2					—BEDPLATE—			
				3								
				4	001	5	N	BEDPLATE		P-1-KL	0246D	
				5								
				6					—PUMP TO BEDPLATE—			
				7								
				8	002	20		→	005203	BOLT HEX SFBS	0224D	1.25-7 X 3.00
		FC		9	003	10			010151	PIN TAPER ROLL	0219D	.313 X 3.50
		11-50 FT		10	004	10			001094	NOT FAS	0205D	.50-13
				11								
				12	005	10			010440	PIN TAPER	0375D	.12 X 5.00
				13								
				14								
				15								
				16								
				17								
				18								
				19								
				20								
				21								
				22								
				23								
				24								
CHK. BY FE		DATE 5/8/78		25	ALT. NO.	DATE						

CHECK. BILL MATERIAL RELEASED | ENGINEERING CLASS | EDITION

85.05/07 22:51 P03 *TBI TURB-TOMP-TRN-SERV

HANDWRITTEN ☐ PARTS LIST & ESTIMATE SHEET ☒ ROUGH BILL OF MATERIAL ☐ ALTERATION — P

☐ CARDS ☐ NO CARDS | M/E | ORDER NO. 707573 | PRODUCT CODE 5310 | B/M 414 | CUSTOMER TVA WATTS BAR NUC. PL. | NOTATION CW | TYPE P

COST ANALYSIS DATA | OUTLINK | ASSEMBLY | ISSUED | COMPLETE | SHEET 13 | OF

MAT'L COST	LABOR COST	BURDEN COST	HOURS	LINE	I.D.P.	TOTAL QTY.	C L	SYMBOL DESCRIPTION	HDW. CODE	HARDWARE DESCRIPTION SYMBOL	MATERIAL CODE	MATERIAL DATA
				1				FOR SERIAL Nº 707573-7				
				2								
				3						MOTOR TO BEDPLATE		
				4								
				5	005	20			005017	BOLT HEX FAS	0224D	.88-9 X 2.25
				6	006	16			010085	PIN TAPER	0219D	9 X 5.00
				7	007	20	M	SHIM		P-298 CZ	0210D	
				8								
				9								
				10								
				11								
				12								
				13								
				14								
				15								
				16								
				17								
				18								
				19								
				20								
				21								
				22								
				23								
				24								
CHK. BY	FE	DATE	4/4/77	25	ALT. NO.	DATE						

ENGRG. BILL OF MAT'L RELEASED 11-14-77 | ENGINEERING CLASS | CONDITION

TITLE: HARDENED CARBON STEEL BOLTS & STUDS

1.0 Scope: This specification covers quenched and tempered bolts to ANSI B18.2.1. # Material shall conform to A449 or A325 Type I

2.0 Quality Assurance:

2.1 Tests - Perform tests of all requirements of this specification. See also 2.2.

2.2 Test Reports; Tests in Excess of the Specification - Furnish certified reports and perform additional tests when indicated by the suffix letter of the material code number in Table I.

NOTE: The suffix letter is specified in the purchase order. If no suffix letter is specified on purchase order, requirements for test reports and/or additional tests shall be as specified on the purchase order.

TABLE I - TEST REPORTS; TESTS IN EXCESS OF THE SPECIFICATION

TESTS, INSPECTIONS, REPORTS	SUFFIX LETTER											
	B		D		J							
Report & added test requirements are special & specified in the P.O.	X											
Test report not required to be furnished			X									
Furnish certified report of chemistry					X							
Furnish certified report of mechanical properties.					X							

3.0 Rejection: The Quality Assurance Table covers test reports, Transamerica Delaval customer source inspection and nondestructive testing only. All other requirements of the specification shall be met or the material will be subject to rejection.

Revision - Included A325 Type I material allowance.

CHG	ALTERATIONS	DATE	BY	CHK
14	Revision	6/25/82	DLG	HBG

TITLE HARDENED CARBON STEEL BOLTS & STUDS

Transamerica Delaval
TRENTON, N.J. 08650 206
SHEET NO. ___ OF ___
D212 0224

GNB Batteries Inc. Industrial Battery Division

2010 Cabot Boulevard West
Langhorne, PA 19047 U.S.A.

Telephone: (215) 750-2600
Cable: GOULNATBAT LANGHORNE, PA
TWX: GOULD LAHN 510-667-2056

ATTACHMENT 5

GNB

B43 '850510 011

May 7, 1985

Tennessee Valley Authority
400 West Summit Hill Drive W8C126
Knoxville, Tennessee 37902

Attn: Mr. ~~Bob Green~~ F.W. CHANDLER, CHIEF, E.E.B.

Subject: Vital Lead Acid Storage Battery Racks
Wattsbar Nuclear Plant
TVA Contract #76K3-85763
Gould Order #K-31850 and
TVA Contract #84X8-832101
GNB Order #515025

Dear Mr. ~~Green~~ CHANDLER

This is to certify that the hardware (bolts, nuts and washers) used for Class 1E batteries for the Wattsbar Nuclear Plant are manufactured to meet the requirements of ASTM Grade A.307 or equivalent.

Attached please find a letter from our supplier of these parts.

If you should have any further questions, please do not hesitate to contact me.

Very truly yours,

Ramesh H. Desai
Manager, Applications Engineering

RHD:dh

Attachment

cc: J. Bucci - GNB

5/10/85 - FWC:PAD
cc: RIMS, SL26 C-K, w/attachment

ELEC ENGR BRANCH
MAY 10 '85
In | Out | Noted

5 341

SEP 5 1984

ASSEMBLY FASTENERS, INCORPORATED

6955 No. Hamlin
Lincolnwood, Illinois 60645

CHICAGO PHONE
Area Code 312
275-5427

Toll Free (Outside Illinois) 800 - 323-4211

LINCOLNWOOD PHONE
Area Code 312
677-4644

TELEX 724389 TELESPAN SKO

March 22, 1984

SEP 5 1984

Legris Manufacturing
Route 6, Box 124
Kankakee, IL 60901

VENDOR'S CERTIFICATION OF COMPLIANCE

Re: Order Placed 10-1-77

Attention: Oscar Legris

Dear Oscar:

We hereby certify that all materials and or parts in subject order are in complete conformance with the requirements of subject order and the requirements of all specifications as listed below.

2 Kegs 1/2-13 x 1-1/4 Hex Hd Grade 2 Bolt
1 Keg 1/2-13 x 1-3/4 Hex Hd Grade 2 Bolt
1 Keg 1/2-13 x 3-1/2 Hex Hd Grade 2 Bolt
1 Keg 1/2-13 x 3-3/4 Hex Hd Grade 2 Bolt
1 Keg 1/2-13 x 4-1/4 Hex Hd Grade 2 Bolt

Above manufactured in accordance with ASTM A307 Grade A Minimum Tensile 60/M PSI.

1 Keg 1/2-13 Hex Nuts

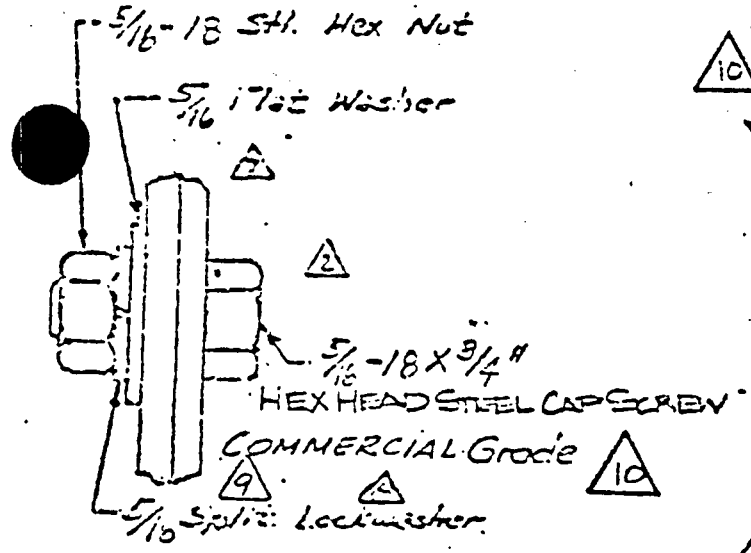
Manufactured in accordance with ASTM A563 Grade A material.

1 Keg 1/2 Medium Split Lockwasher

Manufactured in accordance with ANSI B 27.1 - dated, 1965.

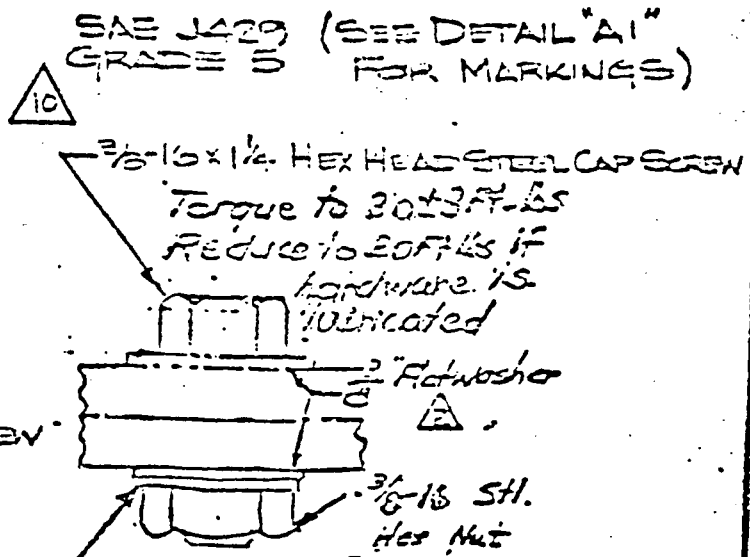
Sincerely,

Stuart M. Mantell
Vice President Sales



Detail "B"

See Note #2



or 3/8" Belleville washer rated 3600lbs

Detail "A"

Same as B, except 1 1/4" Hardware applied

Detail "B1"

DETAIL "A1"

ACCEPTED FOR USE
TENNESSEE VALLEY AUTHORITY
DATE JUN 7 1985
(Elect Engg Br) By: F. W. Chandler

WATTS BAR
74C5-84646

Note #1 This hole only at top of 15" deep vertical sections

#2 Flatwasher, lockwasher & nut assembly may be replaced by a Flange Whiz-Lock Nut from M.F. Company

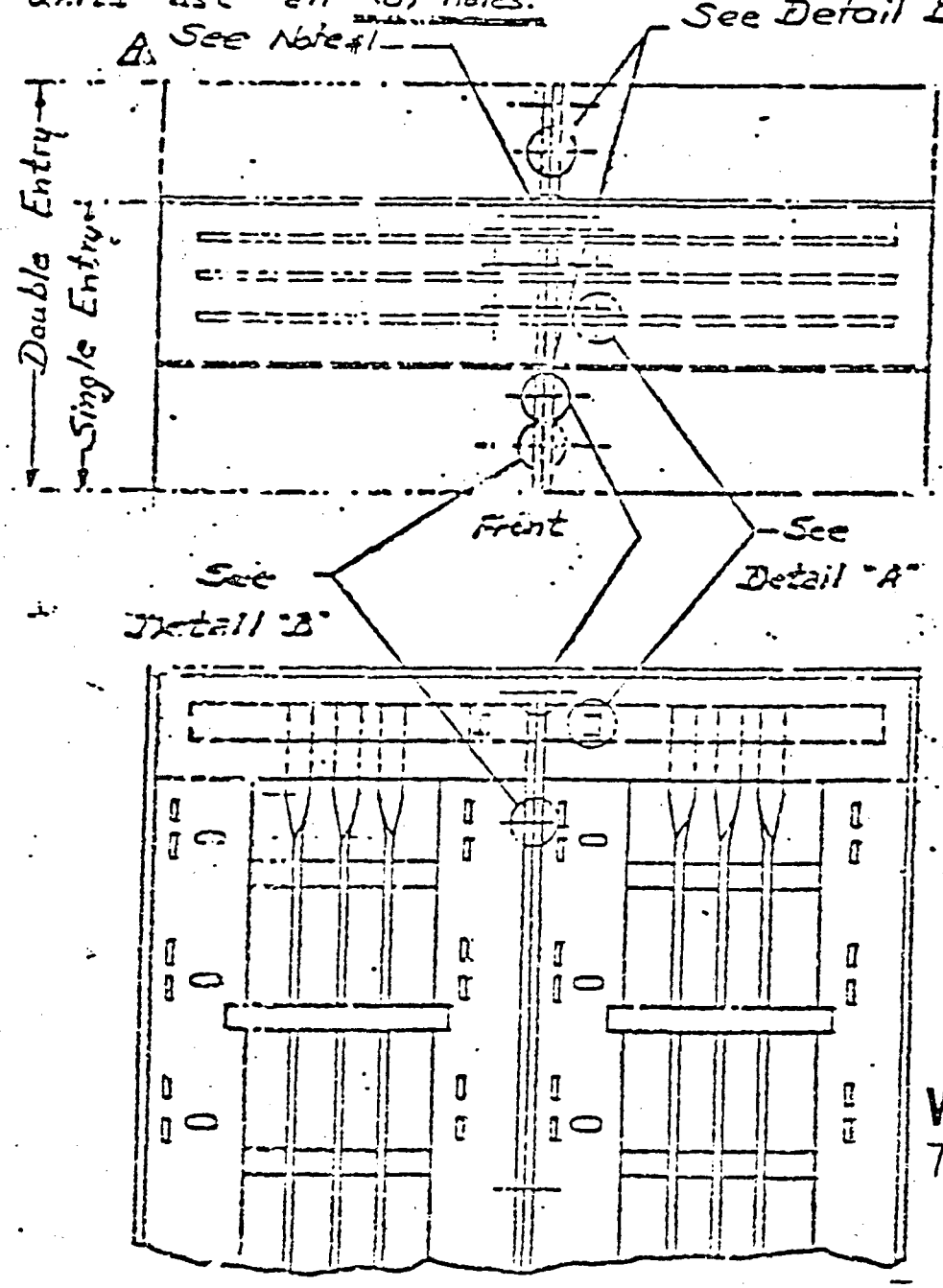
is the property of Gould Inc., and contains proprietary and confidential information which must not be duplicated, used or other than as expressly authorized by Gould.

Scale: —	Prod. Code	Horiz. Bus Link. And Banking Instructions For Field Installation
TOLERANCES Unless Otherwise Specified: Sheet metal Up to 10" ±.03; 10 to 50" ±.06; Hole Punched ±.006; Angle ± 1°; Per RDS 1095 ☐		
Drawn R. Black	Date 10/25/68	GOULD Gould Inc., Distribution & Control Division, Frederick, Md. 21048
Approved	Date	
Approved	Date	Sheet 1 of 1 — Dwg. 03-36418-00 — Rev. 10

Manufacturer of ITE & Rowan Products

Note: For banking Single Entry Units use (4) holes in front of unit and only the (1) top hole in rear of unit. (See Note 1) △

For banking Double Entry Units use all (4) holes.



WATTS BAI
74C5-84644

ACCEPTED FOR USE
TENNESSEE VALLEY AUTHORITY

DATE JUN 7 1985

Rev	Date	DRN	By	Approved	By	Rev	Rev	By	Rev
7	9-29	33896				10	575520	GL	
8	2-12-82	35010							
9	1-27-84	57146							

FORM 322-3C 4

(EDCt Engg Br) By: F. W. Chandler

TENNESSEE VALLEY AUTHORITY

SINGLETON MATERIALS ENGINEERING LABORATORY

KNOXVILLE, TENNESSEE

Date Adopted:	April 1, 1985	Method:	MET-1-EQUOTIP
Date Revised:		Revision:	0
Written By:	Larry E. Smith	Date Approved:	W. H. Childress
Reviewed By:	Paul V. Huttie, Jr.	Approved By:	4/1/85

HARDNESS TESTING USING THE EQUOTIP TESTER

UNCONTROLLED COPY

1.0 SCOPE

To establish the method for use of the EQUOTIP metals hardness tester.

2.0 REFERENCES

2.1 Manufacturer's operating instructions for EQUOTIP hardness tester.

2.2 ASTM E 140 Standard Hardness Conversion Tables for Metals.

3.0 ATTACHMENTS

3.1 Manufacturer's operating instruction for EQUOTIP harndess tester.

3.2 Hardness conversion tables for EQUOTIP measurements.

3.3 Hardness test report.

4.0 GENERAL

4.1 Inspections shall be performed by operators qualified in accordance with SME-QCP 3, "Qualification/Certification of SME Testing Personnel."

4.2 The EQUOTIP hardness tester.

4.2.1 The EQUOTIP hardness tester is designed for testing metallic materials the hardness of which ranges from very low to very high values. Hardness testing can be performed directly onsite and in any position. Typical applications for the EQUOTIP instrument are large, heavy workpieces which are difficult to access. It is especially suitable for applications in which static hardness testing is either not feasible or not economical.

4.2.2 The hardness measurement made by this instrument is a dynamic method predicated upon the principle of energy measurement. During a test an impact body, equipped with a spherically shaped tungsten carbide tip, impacts under a spring force against the test surface from which it rebounds. Impact and rebound velocities are measured. The velocities measured are processed into a hardness value or "L" number which is displayed on the device's digital readout.

4.2.3 The EQUOTIP device is particularly useful for performing hardness tests on installed equipment or structures; rapid testing of multiple measuring areas for examining hardness variations over larger areas; and workpieces for which the indentation made by the hardness test must be as small as possible and may not leave sharp edges.

4.2.4 All tests performed in accordance with this instruction are made with the EQUOTIP hardness tester utilizing the type "D" impact device.

5.0 PROCEDURE

5.1 Materials

5.1.1 This test is applicable to test specimens having a weight exceeding 11 pounds and of compact shape. Curved surfaces to be tested shall exhibit a radius greater than 2 inches (approximately 50 mm). Surfaces having a radius of curvature of less than 3.75 inches (approximately 95 mm) must be tested with the impact device attached to the small diameter support ring. (Surfaces with radii of curvature smaller than 2 inches may be tested provided the impact device is attached to a specialized support ring in accordance with reference 2.1).

5.1.2 Smaller, lighter samples may be tested provided they are coupled to a nonyielding support, such as a heavy baseplate as described in reference 2.1. When the coupling process is carried out properly there is no metallic contact between the item to be tested and the baseplate.

5.1.3 The surface of the material to be tested shall be a reasonably smooth ground surface. A surface roughness comparator may be used as an aid in determining adequate surface finish. The condition of the surface may also be affected by heating or cold working which will result in nonrepresentative hardness readings.

5.1.4 Improperly prepared surfaces can affect the test results as follows:

1. Excessive surface roughness results in lower "L" values. (The true hardness is greater than the measured value and a broad variation of individual measurements is apparent.)
2. Cold-worked surfaces produce excessively large "L" values. (The actual hardness is less than the measured value.)

5.2 Setup

5.2.1 Connect the impact device prior to turning on the instrument switch. When turned on the digital display will show three zeros and battery indicator will be in green portion of its scale. (It the three zeros are not displayed and battery indicator is in red scale, the batteries are discharged.)

CAUTION

THE FOLLOWING PRECAUTIONS SHALL BE FOLLOWED:

1. Do not use the device unless the instrument temperature is above 40°F (5°C).
2. Do not take hardness measurements on critical sealing surfaces.
3. Do not place the cocked impact device against head, hands, arms, etc, and discharge as serious injury may result.

5.3 Calibration of the EQUOTIP Device

5.3.1 The EQUOTIP hardness tester contains no adjustments and therefore only a verification of calibration is necessary.

5.3.2 The calibration verification shall be performed prior to each day's use, after each 4 hours of operation, and each time the battries are replaced. (Batteries are replaced when the indicating meter is out of the green portion or its field.)

5.3.3 Calibration verification is determined by examining the "L" value of the unit's calibration test block provided with the instrument and obtaining a measurement. This value shall be within ± 10 units of the specified "L" value of the calibration test block.

5.3.4 If the deviation from the reference value is greater than ± 12 units, the EQUOTIP device shall no longer be used and must be returned to the manufacturer for servicing.

5.3.5 For deviations greater than ± 6 units but less than or equal to ± 12 units, the unit may still be used, until servicing is required, provided the measured "L" values are corrected as follows:

$$L_K = L \times L_{ref}/L_{act}$$

where:

L_K = the corrected "L" value

L = the "L" value obtained from a test

L_{ref} = the reference "L" from the test block

L_{act} = the "L" value obtained during the calibration verification

5.4 Operation

5.4.1 Allow approximately 5 minutes for instrument "warmup" before taking the first measurements. (For all subsequent measurements, no warmup or waiting is required.)

5.4.2 After selecting an area to be examined, the test shall be conducted by taking two or three readings. The impact device shall be moved at least 1/8 inch (3 mm) after each impact.

5.4.3 Place the impact device on the test surface by hand holding the device on the surface to be examined. Depress the charging tube with the other hand until it is in the cocked and loaded position. (The probe "clicks" when properly cocked and loaded.) Allow the tube to <u>slowly</u> return to its initial position.

5.4.4 Trigger the impact device by lightly depressing the release button atop the probe. Read the "L" value from the digital display.

5.5 Evaluation of Results

5.5.1 A valid test has been obtained when each of the individual readings of the test is within ± 6 units of the average of the measurements taken.

5.5.2 If the variance within the same measuring area exceeds ± 15 units, check whether the surface of the specimen has been adequately ground or whether the sample yields or flexes during the test impact.

5.5.3 The impact device is calibrated for a vertical impact direction (impact from top to bottom). For other impact directions, the measured hardness values (1) must be corrected in accordance with the table provided in attachment 3.1. The correction values shall be subtracted from the measured values.

5.5.4 The "L" value obtained from the test is a direct hardness measurement and can be used as such. This permits optimum utilization of the high accuracy of the EQUOTIP method.

5.5.5 With a certain loss of accuracy, the "L" number hardness value may be converted into equivalent hardness values of other measuring systems such as Vickers, Brinell, Rockwell, "C", etc. Attchment 3.2 provides the necessary charts and tables for converting the "L" values obtained to the various other measuring systems.

6.0 RECORDS AND REPORTS

6.1 Test results shall be documented by means of the report form, attachment 3.3.

A35137.1

ATTACHMENT 3.1

EQUOTIP HARDNESS TESTER

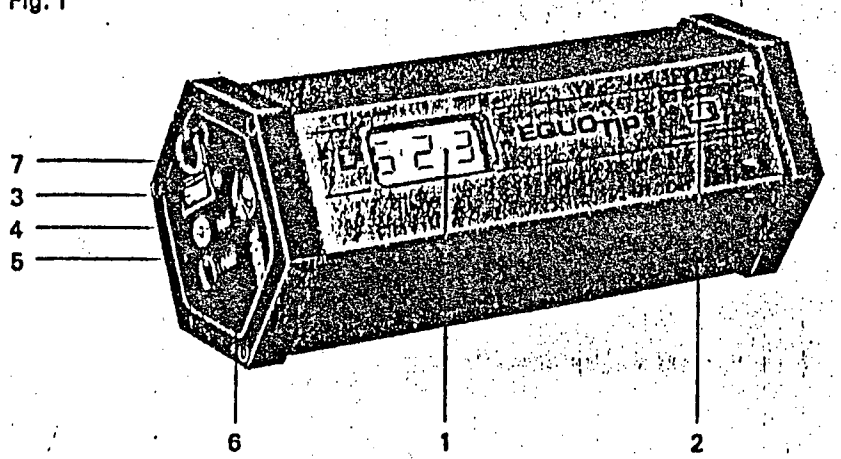
INSTRUCTION MANUAL

Table of Contents

1. EQUOTIP, Designation of Individual Parts 4
2. EQUOTIP Hardness Tester 6
3. Fields of Application 7
4. Operating the Instrument 8
5. Performance of Hardness Tests 10
6. Performance Check and Maintenance of the Instrument 12
7. Treatment of Samples 13
8. Special Characteristics of the EQUOTIP Measuring Method 17
9. Conversion between L-Values and other Hardness Numbers 20
10. Fault Diagnosis 22
11. Notation of Hardness Values 24
12. Standard Test Blocks 24
13. System Accessories 25
14. EQUOprinter 10 30
15. EQUOlimit 32

1. EQUOTIP Designation of the Individual Parts

Fig. 1



1.1 Electronic Indicator Device

1 Digital display of hardness value L
2 Battery checking instrument
3 ON/OFF switch
4 Connecting socket for impact device
5 Connecting socket for EQUOprinter 10 or EQUOlimit
6 Cover for battery holder
7 Suspension eyelets

Basic Unit D

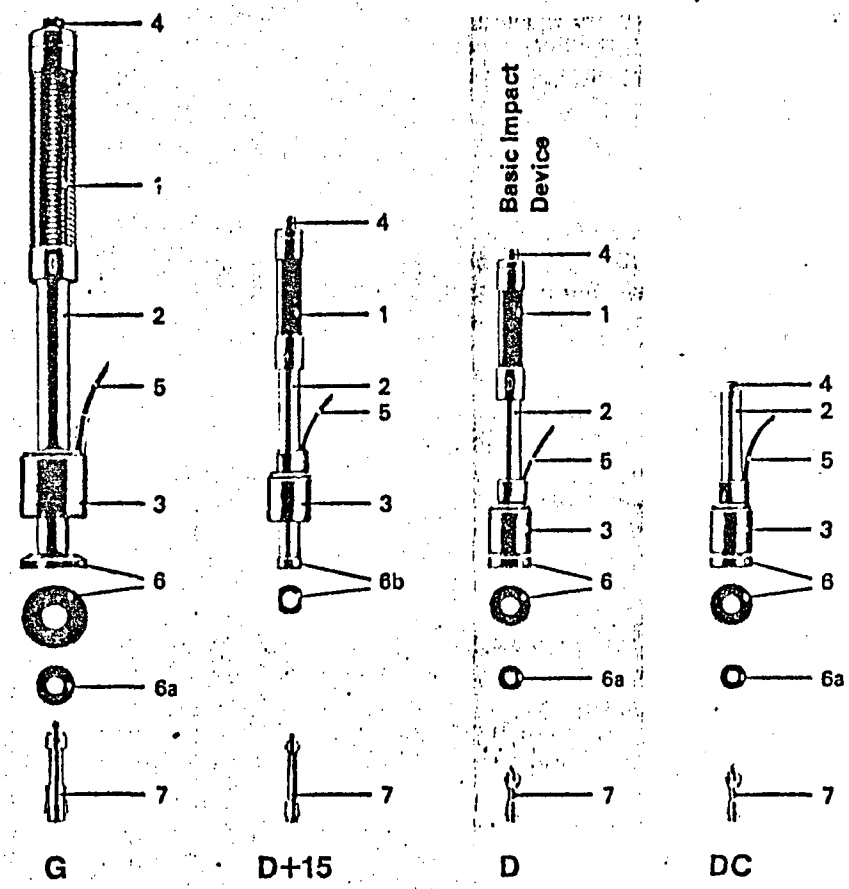
Contents of carrying case
1 Electronic indicator device
1 Impact device D with large support ring
1 Small support ring
1 Standard test block D
1 Can of coupling paste
3 Batteries
1 Cleaning brush

Unit G

Contents of carrying case
1 Electronic indicator device
1 Impact device G with large support ring
1 Small support ring
3 Batteries
1 Cleaning brush
separately packed:
1 Standard test block G

1.2 Impact Devices and Impact Bodies

Fig. 2



1 Loading tube
2 Guide tube
3 Coil holder
4 Release button
5 Connecting cable leading to indicator device
6 Large support ring
6a Small support ring
6b Support ring D+15
7 Impact body with spherical test tip of tungsten carbide

2. EQUOTIP Hardness Tester

The EQUOTIP hardness tester is designed for testing metallic materials the hardness of which ranges from very low to very high values. Hardness testing can be performed directly on-site and in any position. Typical applications for the EQUOTIP instrument are large, heavy workpieces which are difficult to access. It is especially suitable for applications in which static hardness testing is either not feasible or not economical.

2.1 Typical Fields of Application

- Hardness testing of mass-produced parts during manufacturing operation
- Hardness tests on installed machines or steel structures
- Rapid testing of multiple measuring areas for examining hardness variations over larger regions
- Control measurement for the rapid determination of a specific thermal treatment result, e.g. annealed or quenched and tempered
- Workpieces for which the indentation made by the hardness test must be as small as possible and may not leave sharp edges, e.g. on rolls or ground surfaces of machine parts.

2.2 EQUOTIP Measuring Method

The hardness measurements carried out with the EQUOTIP hardness tester is a dynamic method predicated upon the principle of energy measurement.
(EQUO = Energy-QUOtient)
During a hardness test, an impact body, equipped with a spherically shaped tungsten carbide test tip, impacts under spring force against the test surface from which it rebounds. Impact and rebound velocities are measured in a contactless manner at the precise moment, when the spherically shaped tungsten carbide test tip is located approx. 1 mm from the test surface. This is accomplished by a permanent magnet built into the impact body which, during the test impact, travels through a coil. During the forward and rebound movement, electrical voltages are induced which are proportional to the velocities. The measurement values derived from the impact and rebound velocities are processed into the hardness value or number L by the indicator device.

3. Fields of Application

EQUOTIP Measuring Ranges:

The impact device D is the basic impact unit in the EQUOTIP measuring system for testing metallic materials. Compared to the other impact devices, the most universal applicability and the largest number of tables for converting to hardness values of other measuring systems is available for this type.

With impact device D and DC:

For steel and cast steel	(E-Modulus approx. 210 000 N/mm^2)
Range of the L-value	Equivalent static indentation hardness
300–700	80–455 Brinell (F = 30 D^2)
300–890	80–940 Vickers
510–890	20– 68 Rockwell C

For steel and cast steel	(E-Modulus approx. 210 000 N/mm^2)
Range of the L-value	Equivalent Shore hardness
500–900	32.5–99.5 Shore

For cast aluminium alloys	(E-Modulus approx. 65 000–85 000 N/mm^2)
Range of the L-value	Equivalent static indentation hardness
200–560	30–160 Brinell (F = 10 D^2)

Fields of application for other groups of materials are being continuously explored. Appropriate conversion values will be worked out and published from case to case. The user may also compile individual conversion tables for the materials he tests. The corresponding guidelines are contained in Sect. 9.4.
Materials possessing a hardness greater than 940 HV or 68 HRC, such as tungsten carbide, should not be tested (destruction of spherical test tip).

With impact device D+15:

For steel and cast steel	(E-Modulus approx. 210 000 N/mm^2)
Range of the L-value	equivalent static indentation hardness
300–700	59–450 Brinell (F = 30 D^2)
300–890	59–940 Vickers
515–890	20– 68 Rockwell C

Materials possessing a hardness greater than 940 HV or 68 HRC, such as tungsten carbide, should not be tested (destruction of spherical test tip).

With impact device G:
Only for measuring within the Brinell range (90–455 HB)

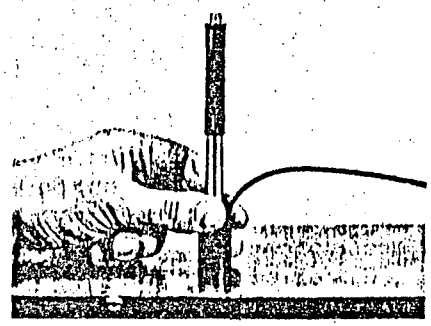
For steel and cast steel	(E-modulus approx. 210 000 N/mm^2)
Range of L-Value	equivalent static hardness
300–650	90–455 Brinell (F = 30 D^2)

Materials possessing a hardness greater than 455 Brinell should not be tested with this impact device (loosening of spherical test tip).

4. Operating the Instrument

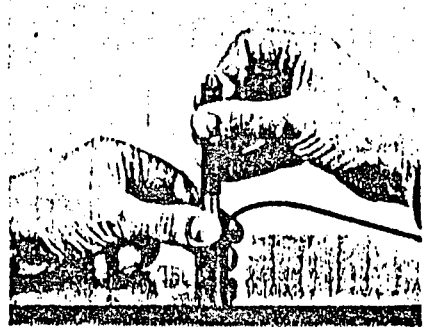
4.1 Indicator Device

- Connect impact device and turn on instrument. Three zeros will appear at the digital display and the battery power indicator moves into the green field.
  If the batteries are discharged, no digital display appears and the indicator will be in the red field. In the event of insufficient battery power, the digital display automatically extinguishes. Thus, erroneous measurements due to insufficiently charged batteries are precluded.
- After turning on the instrument, wait approx. 5 seconds before carrying out the first test. No waiting time is required for subsequent tests.
- The minimum ambient temperature is +5°C. When storing the instrument at temperatures below +5°C it should be allowed to warm up sufficiently before it is placed into operation.

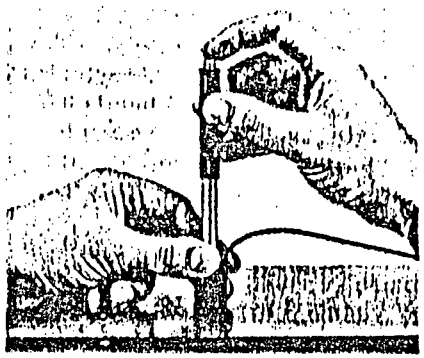


4.2 Impact Devices type D, D+15, and G

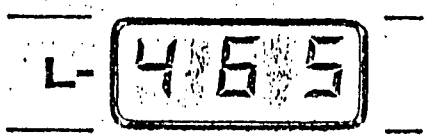
Apply impact device Fig. 3
Place impact device on test surface. The hand holding the device rests on the workpiece.



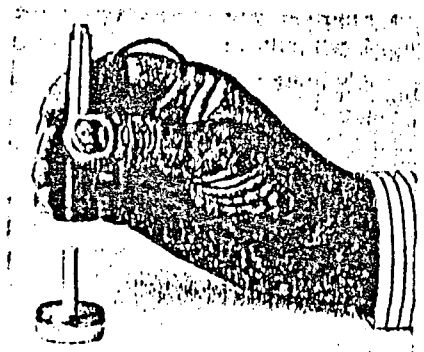
Carrying out the charging movement Fig. 4
Depress charging tube with your other hand until contact is felt, then allow it to slowly return to the starting position. The device is now ready for carrying out the hardness test.



Triggering the test impact Fig. 5
Trigger the impact by exerting light pressure on the release button. The device must be pressed exactly perpendicular to the test surface by means of the coil holder, i.e. the support ring must be flush against the surface of the workpiece.



Reading off the hardness value L Fig. 6
The device is now immediately ready for the next test. The indicated L-value automatically extinguishes with the following test impact.



4.3 Impact device DC

Carrying out the charging movement Fig. 7

Place loading stick adjacent to test area. Plunge face of impact device (coil side) over stick and press down until it reaches the stop position. The device is now ready for operation and the subsequent procedures are identical to those for impact device type D.

5. Performance of Hardness Tests

5.1 Preparations

a) Prepare surface of the workpiece according to the procedures outlined in Sect. 7.1.

b) Observe the recommendations in Sect. 7.2 concerning supporting of the samples.

c) Carry out the performance check discussed in Sect. 6.1.

5.2 Hardness Test

a) Operate the instrument according to Sect. 4.

b) Number of impacts per measuring area
Each measuring area should be tested by at least 3 to 5 impacts. Form an average from the individual measuring values of the hardness value L. Do not impact the same test point more than once.
If the variance within the same measuring area exceeds ±15 L units, check whether the surface of the sample has been adequately ground or whether the sample yields or flexes during the test impact.

c) Minimum spacing of the impact points

Impact devices D, DC and D+15

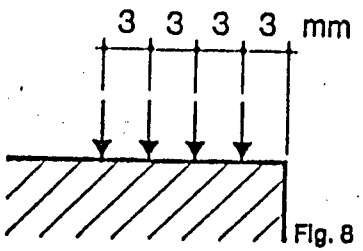


Fig. 8

Impact device G

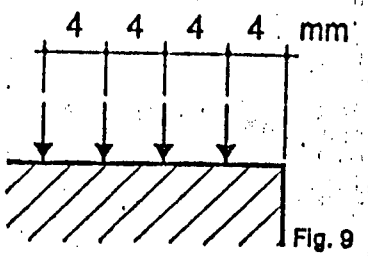


Fig. 9

5.3 Evaluation

a) Impact Direction
The impact device is calibrated for vertical impact direction (impact from top to bottom). For other impact directions, the measured hardness values L must be corrected in accordance with the following table. The correction values must be subtracted from the L-value.

Measured L-value	Correction values for other impact directions: Impact devices D and DC				Impact device D+15				Impact device G			
200												
250	7	14	23	33	8	15	28	41			12	19
300	6	13	22	31	7	14	26	39			11	18
350	6	12	20	29	7	14	25	37			11	17
400	6	12	19	27	7	13	24	35			10	16
450	5	11	18	25	6	13	23	33	2	5	10	15
500	5	10	17	24	6	12	21	31			9	14
550	5	10	16	22	6	12	20	29			9	13
600	4	9	15	20	5	11	19	28			8	12
650	4	8	14	19	5	10	18	26			8	11
700	4	8	13	18	5	10	17	25				
750	3	7	12	17	4	9	16	23				
800	3	6	11	16	4	9	15	22				
850	3	6	10	15	4	8	14	21				
900	2	5	9	14	3	7	13	20				

b) Hardness value L as direct hardness measurement
With regard to a certain group of materials, the hardness value L constitutes a direct hardness measure and can be used as such (see Sect. 8.1). This allows optimum utilization of the high accuracy of the EQUOTIP method.

c) Conversion to hardness values of other methods
With a certain loss of accuracy, the hardness value L can be converted into equivalent hardness values of other measuring systems such as Brinell, Vickers, Rockwell C, Shore, etc. See instructions in Sect. 9 and corresponding **"Conversion Tables"** for the type of impact device used.

6. Performance Check and Maintenance of the Instrument

6.1 Performance Check

The Performance Check controls the mechanical and electronic functions of the impact device and the indicator unit. It is accomplished by measuring the hardness value L of the standard test block applicable to the particular type of impact device (see Sect. 12).

Carrying out the Performance Check:

- Clean an impact device according to Sect. 6.2
- Perform an impact test on standard test block. As a rule, 1 or 2 test impacts are sufficient. The distance between impact location and outer edge of the standard test block should measure at least 5 mm.
- Read off hardness value L and compare with reference L-value. The instrument operates properly if each measured L-value falls within the reference range.

If the deviation from the reference L-value exceeds ±12 L units, the instrument should no longer be used and must be returned to the manufacturer for servicing. With smaller deviations, the L-value can be corrected, until the next service, according to the following formula:

$$L_k = L \frac{L_{ref}}{L_{actual}}$$

L_k = corrected L-value

L = read-off L-value during testing a sample

L_{ref} = reference value from standard test block

L_{actual} = actual value when carrying out measurement operation at the test block

Frequency of Conducting Operational Tests

a) Test instrument is used continuously:
- at least once per day
- the latest after 1000 impacts

b) Test instrument is used periodically:
- before and after conducting a test series

6.2 Maintenance of the Impact Device

The device does not require any particular care other than periodic cleaning of the impact body and the guide tube after performing approximately 1000–2000 tests.

During cleaning, the following procedures need to be observed:

- Unscrew support ring and remove impact body from guide tube
- Clean off any dirt and metallic dust from the impact body and the spherical tip
- Clean guide tube with the special brush provided
- Do not apply oil to any parts of the impact device

7. Treatment of Samples

7.1 Preparation of the Surface

The samples must feature a metallic smooth, ground surface, in order to eliminate erroneous measurements brought about by coarse grinding or lathe scoring. The roughness of the finished surface should not exceed the following values:

Roughness depth	Impact device types	
	D, DC, and D+15	G
R_t	10 µm	30 µm
R_a = CLA = AA	2 µm (=N7)	7 µm (=N9)

R_t = Roughness depth (DIN 4762)
R_a = Average roughness value (Germany)
CLA = Centre line-average value (Great Britain)
AA = Arithmetical average (USA)
N7, N9 = Roughness classification according to ISO/R 1302

When preparing the surface, please observe that the condition of the material may be affected (e.g. due to heating or cold working). As a consequence, the hardness is also influenced. If the surface is inadequately prepared, the measuring results can be affected as follows:

- Excessive surface roughness results in lower L-values (the true hardness is greater than indicated), and broad variations of individual measurements.
- Cold-worked surfaces produce excessively large L-values (the actual hardness is less than measured).

7.2 Supporting the Samples during Testing

For samples weighing more than 5 kg (more than 20 kg in the case of type G) and of compact shape, no particular precautions are necessary. For samples weighing less than 5 kg (less than 20 kg in the case of type G), the following must to be observed:

Despite the low mass of the impact body and low impact energy, a relatively large impact force of short duration is generated when the impact body hits the measuring surface (max. approx. 900 N for device D, DC, and D+15, or max. approx. 2500 N for type G). Smaller and lighter samples or workpieces yield or flex under this force, producing L-values which are too small and of excessively large variation. Even with big or heavy workpieces it is possible for thin-wall regions or thinner protruding parts to yield upon impact. Depending on the frequency of the resilient yielding

action, the measured L-value may be too small or too large. In many situations, potential problems can be checked in the following manner:

a) Samples having a unit weight of 2–5 kg (5–15 kg for device G) and also for heavier samples with protruding parts or thin walls should be placed on a solid support in such a manner that they do not move or flex during the test impact.

b) Samples having a unit weight of less than 2 kg (less than 5 kg for device G) should be rigidly "coupled" with a non-yielding support such as a heavy base plate. Clamping in a vice is of no value, since the samples become exposed to stress and because complete rigidity is never attained. As a rule, the measured L-values would be too small and show excessive variations.

For coupling purposes, a thin layer of coupling paste is to be applied to the contact surface of the sample. Subsequently, the sample should be firmly pressed against the surface of the base plate by moving it with a circular motion (mutual rubbing of the mating surfaces). The coupling process has been carried out properly, if there is still no metallic contact between the parts. During testing, the impact occurs so quickly that the thin layer does not have time to yield. The sample and the support behave as if they were absolutely rigidly interconnected. For the coupling operation, the following prerequisites must be fulfilled:

- The contact surface of the sample and the surface of the base plate must be flat, plane parallel and ground.
- The direction of the test impact must be perpendicular to the coupled surface.
- The samples should have a shape as compact as possible and must weigh at least 100 grams (500 g for device G) and have a thickness of at least 5 mm (10 mm for device G).

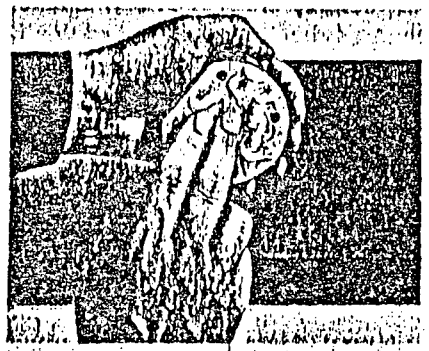
Proper Coupling:

Proper coupling requires a little experience. Insufficiently coupled samples produce large variations of individual measurements, L-values which are too low and the operation is characterized by a rattling noise upon impact of the test tip.

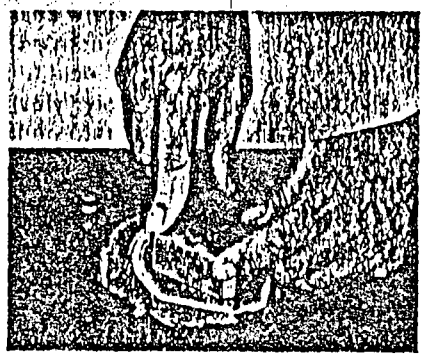
Even with well-coupled samples, individual measuring values tend to vary

more and the deviation is larger when converting to static indentation hardness values than would be the case with heavier workpieces.

The following illustrations show the coupling and testing of a probe with a base plate.



Application of the coupling paste (as thin as possible) Fig. 10



Mutual rubbing of both parts while firmly pressing the sample against the base plate Fig. 11

Testing Fig. 12

A particular advantage of coupling is the possibility of obtaining a very uniform, rigid connection between the sample and the support, totally eliminating stresses at the sample surface. The resulting variation in measured values is very low.

7.3 Samples with Curved Surfaces

Impact testers only work properly, if the impact body has a certain position in the guide tube at the moment of impacting the test surface.
In the normal position, automatically present when testing flat and convex-cylindrical samples (such as round samples), the spherical test tip is located exactly at the end of the guide tube.
However, when testing spherically or cylindrically shaped concave surfaces, the impact body remains further within the guide tube or protrudes further therefrom. Thus, with such types of curved surfaces, it is to be observed that the radii of curvature do not drop below the values indicated in Fig. 13.
Strongly curved surfaces should always be tested with the small support ring.

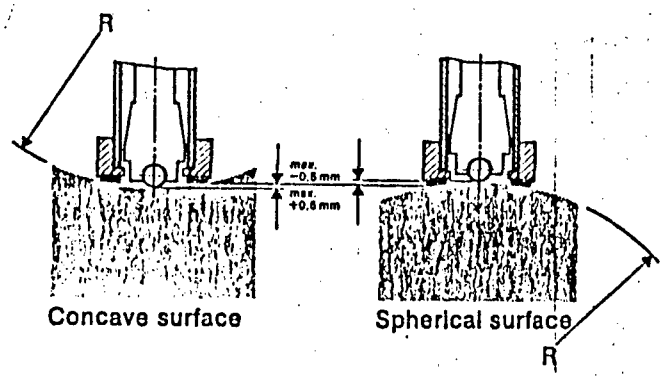


Fig. 13

Impact device types D, D+15, and DC	R > 30 mm
Impact device type G	R > 50 mm

For impact devises D, DC, and D+15, special support rings are available to accommodate smaller radii on convex or concave surfaces (see page 26).

8. Special Characteristics of the EQUOTIP Measuring Method

8.1 Hardness Value L

The measure of hardness used in the EQUOTIP method is the hardness value L. This value is the quotient obtained by dividing the rebound velocity V_R by the impact velocity V_A, multiplied by a factor of 1000. The term L-value is named after the inventor of this measuring principle, Dipl.-Ing. Dietmar Leeb.

$$L = 1000 \frac{V_R}{V_A}$$

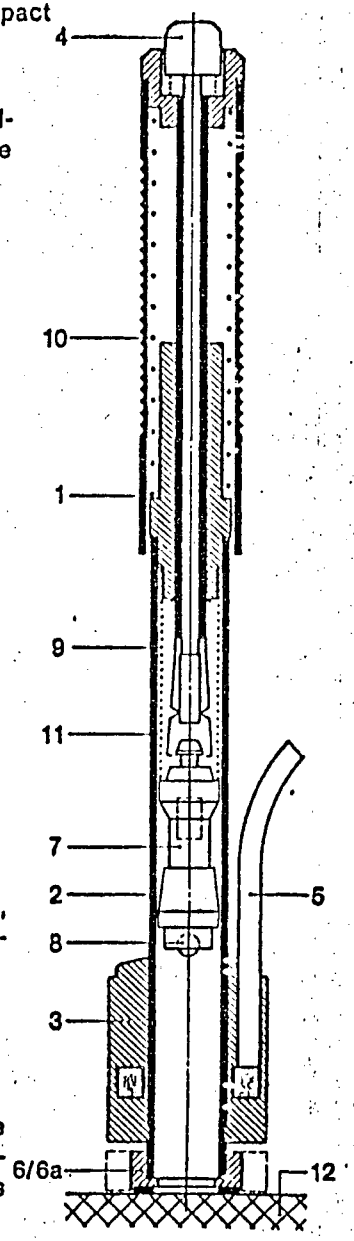
Since the impact velocity remains constant for a given impact direction, this value is proportional to the rebound velocity. The rebound velocity increases with the material hardness. In principle, the hardness value L rises with increasing hardness of the material tested.
The measuring value is influenced not only by the hardness or strength, but also by the modulus of elasticity as well as the elastic limit respectively yield point. The hardness value L, therefore, constitutes a characteristic value of both plastic and elastic behavior of the material, since both factors are automatically measured conjointly.
Regarding the elastic properties, the influence of the E-modulus is of particular importance. With materials of the same static hardness but different magnitude of the E-modulus, those having a smaller E-modulus will characteristically produce a larger L-value. For instance, a steel sample (E-modulus about 210 000 N/mm^2) with a Brinell hardness of 150, possesses an L-value of 416 (impact device D) while an aluminium sample (E-modulus about 70 000 N/mm^2) also with a Brinell hardness of 150, has an L-value of 542 (impact device D).
Since the "elastic properties" differ from one material to another, the hardness value L only represents direct measure of hardness, if it is related to a certain group of materials.
Generally speaking, the hardness value L can only be compared to a limited extent with conventional static indentation hardness values. In contrast to the EQUOTIP method, only the predominantly plastic properties are measured by static hardness testing systems.
By grouping the different types of metals in terms of their E-modulus, alloying and treatment, it is possible to develop highly usable conversion curves for converting the hardness values or numbers for use in practical work.

8.2 Schematic Design of the Impact Devices D, DC*, D+15 and G.

Status at the moment of triggering the impact (impact spring stressed)

* The model DC is not equipped with a loading tube, since it is loaded with a separate loading stick.

Fig. 14



1 Loading tube
2 Guide tube
3 Coil holder with coil
4 Release button
5 Connecting cable leading to the indicator device
6 Large support ring
6a Small support ring
7 Impact body
8 Spherical test tip
9 Impact spring
10 Loading spring
11 Catch chuck
12 Material to be tested

The device should not be disassembled, otherwise misadjustments in the spring system and the transmitter will occur.

Use of support rings
Large ring: for all standard situations
Small ring: for more exact placement of the individual impacts and for testing strongly curved surfaces (see Sect. 7.3).

8.3 Technical Specifications for EQUOTIP Hardness Testers

Measuring Accuracy (see also Section 9.2)

a) When using the hardness value L as the direct hardness number
- average measurement deviation of the L-value with repetitive individual measurements at the same test location: max. ± 4 L units throughout the entire measuring range (±0,5% relative to L = 800)

b) When converting the hardness value L into static indentation hardness numbers (HB, HV, or HRC)
- mean conversion deviation depending on measuring range and static method: ±3% to ±15%

c) When converting hardness value L into Shore hardness
- mean conversion deviation depending on measuring range: ±1.5% to ±4.5%

EQUOTIP Indicator Device

Battery set	3 single 1.5 V batteries
Operating time of battery set at 20°C	approx. 50 hours
Operating temperature	+5°C to +50°C
Printer connection	
Dimensions	245 x 112 mm
Weight	approx. 900 g incl. batteries

Impact Devices		D, DC	D+15	G
Mass of impact body	g	5.5	7.8	20.0
Impact energy	Nmm	11.0	11.0	90.0
Diameter of spherical test tip	mm	3.0	3.0	5.0
Diameter of impact device	mm	20	20	30
Length of impact device	mm	150/185	165	250
Material of spherical test tip	tungsten carbide, hardness approx. 1600 HV			

9. Conversion between L-Values and other Hardness Numbers

9.1 Conversion Tables

For comparison between hardness value L and hardness numbers of other systems such as Brinell, Vickers, Rockwell C, etc., conversion curves and tables have been compiled. In order to develop these comparative values, a large number of standard test blocks (according to DIN 51303–1975 and JIS 7731–1976) were tested with the EQUOTIP method, followed by tests with other hardness measuring methods. The measuring data obtained were processed into conversion tables using the method of least squares (non-linear regression).

9.2 Conversion Deviations

The conversion deviation is the variance resulting from the comparison of measuring values observed with different hardness testing methods. It includes 2 components. The major share is caused by the fact that there is no clear physical relationship between the various methods. The second component results from the circumstance that the comparison of hardness values (e.g. L-value and Brinell) also includes the measuring deviation of the method being compared to.

Therefore, a conversion between hardness values contains inaccuracies from the outset. This applies not only to conversion of the L-value into static indentation hardness values, but also for converting from one static hardness measuring method to another. The conversion deviations (±HB, ±HV, etc.) indicated in the "conversion tables" represent "standard deviations", i.e. 68% of all materials tested to date fell within the specified variance range.

9.3 Deviation from Conversion Values

Deviations from the values in the conversion table can occur with the following steel qualities:

High-Alloyed Steels

- All austenite steels
- In high-speed tool steels, hotwork steels, and ledeburite chromium steels (group of high-carbon cold-work steels), the hard materials embedded in the matrix (ledeburite tungsten carbide e.g. type M7C3 and M6C) cause a local increase of the E-modulus, resulting in L-values which are actually too low. A typical representative of this group is the tool steel for cold work X210Cr12 (Material No. 1.2080) containing 2.1% C and 12% Cr.

Cold Work-Hardened Steels

- Drawn and in part also rolled steels frequently lead to exessively high L-values due to the pronounced cold-worked regions near the surface which simulate higher than actual hardness. Such steels should always be tested over their entire cross-section.

Magnetic Steels

- When testing magnetic materials, the velocity transmitter in the impact body is briefly influenced by their magnetic field. Therefore, slight deviations of the measured L-values may occur.

Surface-Hardened Steels

- Surface-hardened steels and especially case-hardened steels produce L-values which are too low because of their soft core. Layer thicknesses measuring exceeding 0.8 mm do not influence the L-value. By establishing plant-internal conversion curves according to Sect. 9.4, the testing of surface-hardened steels may nevertheless be possible.

9.4 Setup of Plant-Internal Conversion Curves

For the special situations mentioned in Sect. 9.3, or when testing materials for which no generally applicable conversion tables are available, the user can develop individual conversion tables.

When developing conversion curves, the following points must be observed:

- The sample surface must be prepared very carefully.
- If possible, samples should be of a size which makes coupling to a support base unnecessary.
- The correct readout of the EQUOTIP hardness tester is to be checked against the standard test block for each test series.
- The function of the static hardness testing machines and the correct optical evaluation of the indentations is to be checked for each test series, with the aid of standard test blocks of corresponding measuring range.
- Only such hardness values should be correlated which are directly derived from immediate proximity to the relevant measuring area. To obtain a pair of comparative values, always form a mean value from at least 10 to 15 L-values and 3 static indentation hardness values.

Example:
3 measurements Brinell
3 x 5 measurements EQUOTIP

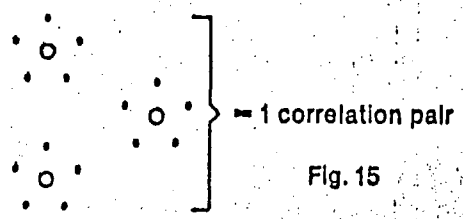


Fig. 15

10. Fault Diagnosis

Indication	Cause	Possible Remedy
No digital readout	– dead batteries – batteries improperly poled – no contact at negative battery pole – no battery in holder	correct defect
	– indicator device too cold (temp. <+5°C)	warm up device
Digital display does not move	– poor cable contact or cable broken	plug in cable completely, or even possibly replace cable
	– the tested material is extremely homogenous	
No impact occurs	– impact body is not or improperly located in the impact device	correct defect
	– impact body does not release or cannot be loaded	service the catch chuck or release mechanism
Marked deviation of individual L-values or L-values constantly too low	– measuring area inadequately prepared	prepare sample according to Section 7.1
	– the tested material is extremely inhomogenous or porous	
	– sample is insufficiently supported	support sample according to Section 7.2
	– sample exhibits large local hardness differences e.g. at the transition from the welding seam to the base material	
	– impact direction has been changed between the individual impacts	Please see corrections for other impact directions
L-values at the standard test block constantly too low	– impact device contaminated	clean impact device according to Section 6.2
	– spherical test tip cracked (e.g. due to impact against tungsten carbide)	replace impact body
	– support ring does not have rubber pad	replace support ring
L-values at the standard test block constantly too high	– spherical test tip flattened (impact against tungsten carbide, wear)	replace impact body
	– standard test block damaged or full of indentations	replace standard test block

11. Notation of Hardness Values

To avoid confusion between:
- L-values measured with different impact devices (different conversion tables are applicable for each impact device type)
- Hardness values of other measuring methods converted from the L-value and those measured directly by the respective system, the following form of notation is recommended:

a) for L-Values
The letter identifying the impact device used in establishing the measurements is used as a suffix to the L-value
L_D, L_{D+15}, L_G
Example: L_D = 760 (= L-value measured with impact device type D)

b) L-values converted into values of other measuring methods
The converted hardness value is suffixed with an L, together with the letter identifying the impact device used in the original measurement

HBL_D	HVL_D	$HRCL_D$	HSL_D
HBL_{D+15}	HVL_{D+15}	$HRCL_{D+15}$	
HBL_G			

Examples:
(L_{D+15} = 402) ← HBL_{D+15} = 125 or 125 HBL_{D+15}
(L_D = 770) ← HSL_D = 74.2 or 74.2 HSL_D

12. Standard Test Blocks

Standard Test Block D (weight 2.7 kg)
The L-value, together with the suffix D, is inscribed on this block as follows:

D 9.80	L_D = 840±6	HV100 = 782±15
Internal manufacturing number	Reference L-value	Vickers comparative measurement

This block is destined for use with impact devices D, DC, and D+15. If the measurements fall within the reference value, the impact device and indicator unit operate properly throughout the entire measuring range.
- The block must be removed from the carrying case and placed on a solid, firm base prior to testing.
- The impact device type G (only applicable within the Brinell range up to 455 HB) must not be tested on this block because it is far too hard (approx. 800 HV). This would result in damage to the spherical test tip.

Standard Test Block G (weight 6.5 kg)
Two different L-values together with the suffix G and D are inscribed on this block as shown in the following example:

G 2.80	L_G = 575±6 (L_D = 615±6)	HB 5/750 = 345±8
Internal manufacturing number	Reference L-value	Brinell comparative measurement

This block is primarily destined for use with impact device G, for which the upper value is applicable.
The value in parentheses applies to impact devices D and DC, provided they are only used within the Brinell range. For checking these devices throughout their entire measuring range (up to L = 900 or 940 HV), the test block D must be used.
Densely impacted test blocks cannot be restored by grinding. Reason: through grinding, the original hardness is altered in an uneven and uncontrollable manner. Therefore, the test block can neither be calibrated for a new mean value nor for an acceptable ± tolerance.

13. System Accessories

For special test applications, the following system accessories have been developed:
EQUOprinter 10
Immediately prints individual measurement values and forms a mean value. Correction factors (impact device type, impact direction) are automatically processed when applicable.

4.3.3 Carbon steel used for the pressure retaining parts shall be ASME Grade with the following requirements:

a. A fine grade melting practice shall be used in the steel making process and this fact shall be recorded in the certified test report of each heat.

b. The carbon steel shall be in the normalized and tempered condition. This fact shall be recorded in the certified test report.

c. The surfaces exposed to boric acid fluid shall be clad with austenitic stainless steel weld deposit consisting of a minimum of 18.0% Cr and 8.0% Ni and a maximum of 0.08% carbon. The first layer shall be of Type 309 stainless steel. The weld overlay cladding shall be tested in accordance with Ⓦ PS 84201 LH.

4.3.4 Unless otherwise stated in the purchase order, all pressure retaining materials shall meet impact testing requirements specified in ASME Section III, Paragraph NC-2310.

3.5 To prevent galling with surfaces exposed to working fluids, thread lubricants consisting of colloidal graphite in isopropanol (Neolube Huron Industries or equivalent) shall be used.

4.4 Unacceptable Materials

4.4.1 The repair of leaks and defects in pressure castings by peening or by the use of cement compounds is prohibited. Cosmetic weld repairs shall not be performed.

4.4.2 Plating on any surface exposed to pumped fluid is prohibited.

4.4.3 Nitrided surfaces are prohibited.

4.4.4 Lead, mercury, or other low melting metals their compounds or materials containing low melting metals as a basic chemical constituent shall not be used in direct contact with the stainless steel surfaces of these pumps at any time. This prohibition includes tooling, fixtures marking materials, fluxes, temperature crayons, paints, coatings, etc, used during fabrication.

4.4.5 Iron and copper contamination shall not be present on the surfaces of austenitic base materials used in these pumps. Where contamination may be suspected to exist by Ⓦ PWRSD representative, a copper sulfate or other appropriate test shall be performed at selected locations.

4.4.6 The use of materials containing chloride and/or fluorides at a level greater than 10 ppm is prohibited.

4.5 Weld Filler Material

a. Type 308 weld filler material shall be used for all welding applications. As an option, Type 308L weld filler metal analysis may be substituted for consumable inserts when this technique is used for the weld root closure. Bare weld filler metal materials, including consumable inserts used in inert gas welding processes, shall conform to ASME SFA-5.9 and shall be procured to contain not less than 5% delta ferrite. All weld filler metal materials used in flux shielded welding processes shall conform to ASME SFA-5.4 or SFA-5.9 and shall be procured in a wire-flux combination to be capable of providing not less than 5% delta ferrite in the deposit. Electrodes conforming to SFA-5.4 shall be of the -15 or -16 current characteristics.

All welding materials shall be tested by the fabricator using the specific process(es) and the maximum welding energy inputs to be employed in production welding. These tests shall be in accordance with the requirements of ASME Section III, NB 2430 and in addition, shall include delta ferrite determinations. These determinations shall arbitrarily be by calculation using the "Schaeffler or McKay Constitution Diagram for Stainless Steel Weld Metal". Subsequent in-process delta ferrite determinations are not required. (NOTE: Other methods of ferrite determination may be mutually considered for agreement on the basis of the developmental data and recommendations concurrently existing from the Advisory Subcommittee for Welding Stainless Steel of the High Alloy Committee in the Welding Research Council).

b. The use of fabricated composite stainless steel electrodes and filler metals may be used provided that the requirements of Ⓦ PS 80280VM are met.

TENNESSEE VALLEY AUTHORITY

SINGLETON MATERIALS ENGINEERING LABORATORY

HARDNESS TEST REPORT

PROJECT: WATTS BAR NUCLEAR PLANT UNIT 1 | DATE PERFORMED: 5-2-85

COMPONENT TYPE: BATTERY ROOM I | EQUOTIP S/N: 37-0063

COMPONENT/PART IDENTIFICATION	HARDNESS READINGS (L_D) 1	2	3	AVERAGE HARDNESS (L_D)	MAXIMUM DEVIATION FROM AVERAGE	POSITION CORRECTION: POSITION	CORRECTION	CORRECTED HARDNESS (L_D)	HARDNESS CONVERTED TO * BRINELL	REMARKS
A 14257 - 1	506	494	493	497	4	⊣	10	487	208	
- 2	504	504	500	502	2	⊣	10	492	213	
- 3	486	489	484	486	3	⊣	10	476	199	
- 4	484	482	482	483	1	⊣	10	473	196	
- 5	523	521	531	525	6	⊣	10	515	235	
A 14258 - 6	477	481	484	480	4	⊣	10	470	193	
- 7	487	488	485	486	2	⊣	10	476	199	
- 8	485	493	495	491	6	⊣	10	481	203	
- 9	485	488	492	488	4	⊣	10	478	200	
- 10	527	523	525	525	2	⊣	10	515	235	
A 14260 - 11	499	492	489	493	6	⊣	10	483	205	
- 12	500	490	496	495	5	⊣	10	485	207	
- 13	489	494	487	490	4	⊣	10	480	202	
- 14	508	513	510	510	3	⊣	10	500	221	
- 15	490	487	492	489	3	⊣	10	479	201	

* - BRINNEL, ROCKWELL C, etc.

CALIBRATION CHECK

	TIME	NO. 1	NO. 2	NO. 3	SAT/UNSAT
INITIAL	7:05 pm	758	752	755	SAT
SUBSEQUENT 1					
SUBSEQUENT 2					
SUBSEQUENT 3					

PERFORMED BY: Paul V. Hutchins, L. | DATE: 5-2-85

REVIEWED BY: Craig Cartell | DATE: 5-10-85

TENNESSEE VALLEY AUTHORITY

SINGLETON MATERIALS ENGINEERING LABORATORY

HARDNESS TEST REPORT

PROJECT: WATTS BAR NUCLEAR PLANT UNIT 1 | DATE PERFORMED: 5-2-85

COMPONENT TYPE: BATTERY ROOM II | EQUOTIP S/N: 37-0063

COMPONENT/PART IDENTIFICATION	HARDNESS READINGS (LD) 1	2	3	AVERAGE HARDNESS (LD)	MAXIMUM DEVIATION FROM AVERAGE	POSITION CORRECTION: POSITION	CORRECTION	CORRECTED HARDNESS (LD)	HARDNESS CONVERTED TO *	REMARKS
A 14289 -1	521	526	529	525	4	⊣	10	515	234	
-2	525	529	530	528	3	⊣	10	518	238	
-3	524	523	528	525	3	⊣	10	515	234	
-4	516	509	512	512	4	⊣	10	502	222	
-5	486	482	484	484	2	⊣	10	474	197	
A 14290 -6	489	491	494	491	3	⊣	10	481	203	
-7	524	531	523	526	5	⊣	10	516	236	
-8	528	527	522	525	3	⊣	10	515	235	
-9	529	533	526	529	4	⊣	10	519	239	
-10	526	525	523	525	2	⊣	10	515	235	
A 14292 -11	482	480	478	480	2	⊣	10	470	193	
-12	512	511	513	512	1	⊣	10	502	222	
-13	530	526	527	527	3	⊣	10	517	237	
-14	527	523	533	527	6	⊣	10	517	237	
-15	520	522	515	519	4	⊣	10	509	229	

* - BRINNEL, ROCKWELL C, etc.

CALIBRATION CHECK

	TIME	NO. 1	NO. 2	NO. 3	SAT/UNSAT
INITIAL	7:35 pm	756	759	754	SAT
SUBSEQUENT 1					
SUBSEQUENT 2					
SUBSEQUENT 3					

PERFORMED BY: Paul V. Hutchins, Jr. | DATE: 5-2-85

REVIEWED BY: Craig R Cantrell | DATE: 5-10-85

ATTACHMENT 13
SUMMARY OF UNMARKED BOLTING INVESTIGATION RESULTS -
SPECIFIED MATERIAL VERSUS MATERIAL IDENTIFIED BY HARDNESS TESTING

Component	Specified Material	Material Identified by Hardness Testing	Disposition
Containment Spray Pump	ASTM A193 Gr. B7	ASTM A449 (Visual Exam.)	NCR WBNNEB8510
Component Cooling Water Pump	ASTM A449	ASTM A449 (Visual Exam.)	Material OK
Residual Heat Removal Pump	ASTM A307 Gr. B	ASTM A307 Gr. B	Material OK
Centrifugal Charging Pump	ASTM A325	ASTM A325	Material OK
Positive Displacement Pump	ASTM A193 Gr. B7	ASTM A193 Gr. B7	Material OK
Vital Lead Acid Storage Battery Rack	ASTM A307 Gr. A	ASTM A307 Gr. A	Material OK
480V Reactor MOV Boards	ASTM A307	ASTM A307 (Visual Inspection)	Material OK
Top Pump Vent Flange Bolts	ASTM A193 Gr. B7	Various Lower-Strength Materials (Visual Exam.)	Bolts Replaced Under MR 526555

WATTS BAR NUCLEAR PLANT
EVALUATON OF SUPPLIER'S
QUALITY ASSURANCE PROGRAM
(MATERIAL CONTROL - BOLTING)

TVA safety-related equipment is procured in accordance with the requirements of its topical report, which is approved by the NRC. Detailed division and branch level engineering procedures have been developed, implemented, and audited by TVA and NRC personnel to assure their compliance with topical requirements. These procedures require that each contract for safety-related equipment be reviewed in detail by qualified employees to assure compliance with all TVA licensing commitments prior to their award. TVA contracts for safety-related equipment require each supplier to have an established documented quality assurance program which, at a minimum, addresses the applicable requirements of 10 CFR 50, Appendix B. Except as noted in the Safety Analysis Report, all contracts for pressure boundry components were procured to ASME Section III requirements which also adequately address quality assurance requirements for ASME code suppliers and manufacturers.

Identification and control of materials, parts, and components are the prime responsibility of the manufacturer or supplier of safety-related equipment. The measures established for the identification and control of materials, parts, and components are normally described in the supplier's quality assurance manual (QAM). Supplier QAMs are reviewed and accepted in accordance with approved TVA procedures by the appropriate quality assurance organization. Qualified TVA personnel conduct detailed quality assurance audits of suppliers of safety-related equipment to determine the degree of implementation, adequacy, and effectiveness of their quality assurance program. Any discrepancies observed in the supplier's quality assurance program are documented and require implementation of corrective action by the supplier and verification of implementation of corrective actions by TVA.

Bolting material is one of many items for safety-related equipment that requires measures be developed to assure that identification is maintained by heat number, type, grade, or other appropriate means, either on the item or on records traceable to the item, as required throughout fabrication, errection, installation, and use. As previously noted, it is the supplier's responsibility for material control. TVA audits their quality assurance program to assure compliance. TVA also performs source surveillance on most of the safety-related equipment it buys. TVA utilizes personnel in their Quality Engineering Branch field offices to monitor the quality control activities of suppliers and manufacturers while performing source inspections. This has provided TVA with additional assurance that the material being supplied is in compliance with the TVA contract specifications.

In the case of bolting material, these inspection activities could consist of performing 100-percent source inspection of each bolt, stud, or nut to spot checking the manufacturers stock material for compliance with his purchase order. The degree of inspection is directly related to the requirements of the TVA contractual technical specifications, unless the inspector has reason to question the integrity of the material. If the inspector questions the integrity of the material, he may require additional tests be performed on the material.

In the case of both electrical and mechanical equipment requiring bolting material, it is the supplier's responsibility for assuring that the bolting material is adequate for its intended purpose and meets design specifications. Supplier documentation does not always identify bolting

material specifications; however, this information can normally be obtained from supplier subtier drawings and bills of materials for specific part numbers. Some suppliers have supplied TVA with certificates of conformance for bolting material that was not marked.

It has been noted industry wide that some bolting manufacturers have interpreted the ASTM A307 bolting specification to not require bolting materials to be marked. Thus, some bolts, although procured in accordance with an approved quality assurance program, may not be marked. Nevertheless, it is TVA's position that this situation does not impair the quality of those bolts since they were procured in accordance with an acceptable quality program and received with appropriate documentation and certifications.

EQUOlimit

Upper and lower limit values L are preselected with two coding switches. For each measurement, a check is made to determine whether the actual value falls below, within, or above the established limits. The result is signalled optically and acoustically. EQUOlimit can also perform external control functions.

Impact Devices

In addition to the basic impact device D, the following special impact devices are available as accessories:

Impact Device D+15

Typical applications:
Measuring of races in large ball bearings
Checking of gear teeth
Hardness measurement in grooves

Special feature: one of the key advantages of the impact device is its extremely slender shape and the recessed measuring coil. For this reason, the impact body is somewhat longer, resulting in different conversion tables.

Impact Device Type G

Typical applications:
Hardness measuring of large, forged steel parts within the Brinell range (90–455 HB).

Larger diameter of spherical test tip (diam. = 5 mm). Lower preparatory requirements for measuring surfaces than with impact device D.

Impact Device DC

Typical applications:
For measuring under very restricted space conditions e.g. inside bores, interior of machines, etc. In other respects, the application range is identical to device D and the same conversion tables apply.

Special feature: the impact device DC is loaded with a special loading stick. The impact body is identical to the one used in type D.

Support Rings for Impact Devices D/DC/D+15/G

Part designation and dimensions:		suitable for the following test surfaces:	
D6	ø 19.5 x 5.5 mm	R> 60 mm	plane cylindrical hollow-cylindrical spherical hollow-spherical

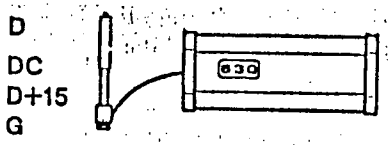
Part designation and dimensions:		suitable for the following test surfaces:	
D6a	ø 13.5 x 5.5 mm ø 19.5 x 5.5 mm	R> 30 mm	plane cylindrical hollow-cylindrical spherical hollow-spherical
		cylindrical	
Z 10–15 Z 14.5–30	20 x 20 x 7.5 mm 20 x 20 x 6.5 mm	R 10 mm – 15 mm R 14.5–30 mm R< 10 mm not possible R> 30 mm D6/D6a	
		hollow-cylindrical	
HZ 11–13 HZ 12.5–17 HZ 16.5–30	20 x 18 x 5 mm 20 x 20 x 5 mm 20 x 20 x 5 mm	R 11 mm – 13 mm R 12.5 mm – 17 mm R 16.5 mm – 30 mm R< 11 mm not possible R> 30 mm D6a	
		spherical	
K 10–15 K 14.5–30	ø 20 x 7.7 mm ø 20 x 6.7 mm	R 10 mm – 15 mm R 14.5 – 30 mm R< 10 mm not possible R> 30 mm D6/D6a	
		hollow-spherical	
HK 11–13 HK 12.5–17 HK 16.5–30	ø 17 x 5 mm ø 18 x 5 mm ø 20 x 5 mm	R 11 mm – 13 mm R 12.5 – 17 mm R 16.5 – 30 mm R< 11 mm not possible R> 30 mm D6a	
UN	52 x 20 x 16 mm		

Part designation and dimensions:		suitable for the following test surfaces:	
D6b/D+15	13.5 x 10.8 x 5.5 mm	R> 30 mm	plane cylindrical hollow-cylindrical spherical hollow-spherical
G6	ø 29.5 x 7 mm	R> 100 mm	plane cylindrical hollow-cylindrical spherical hollow-spherical
G6a	ø 19.5 x 7 mm	R> 50 mm	plane cylindrical hollow-cylindrical spherical hollow-spherical

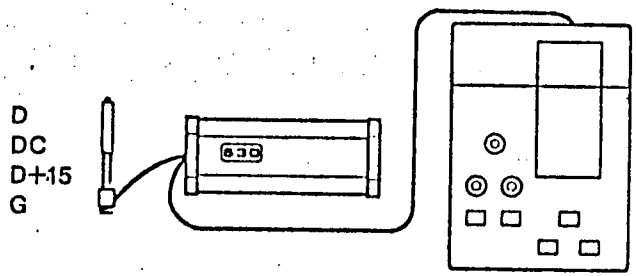
<: less than... >: equal to or greater than...

13.1 System Combinations

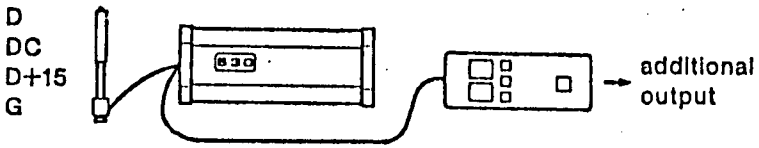
Combination 1
Impact Device + Indicator Device = Basic Unit D



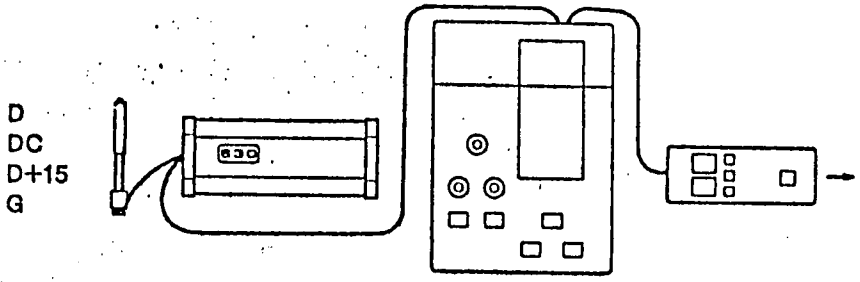
Combination 2
Impact Device + Indicator Device + EQUOprinter 10



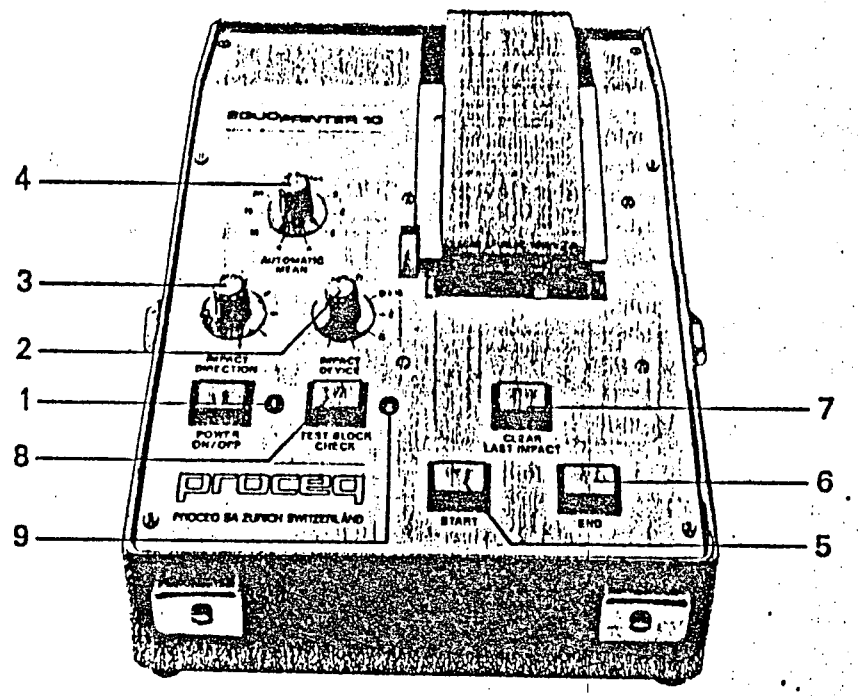
Combination 3
Impact Device + Indicator Device + EQUOlimit



Combination 4
Impact Device + Indicator Device + EQUOprinter 10 + EQUOlimit



14. EQUOprinter 10



14.1 Operating Instructions

- Connect cable to EQUOTIP indicator device and to the AC mains – if available (check technical data of power supply).
- Depress key 1 "POWER ON". Power control lamp lights up.
- Set appropriate impact device type with program selector 2.
- Preselect impact direction with selector 3.
- Turn selector 4 to the desired number of individual measurements from which the mean value is to be automatically formed.
  In the "MAN"-position, any number of measurements can be taken and the mean value is formed by depressing the "END" key 6.
- "START" key 5 initiates printout of the basic text. The preselected settings are confirmed on the recording strip.
- The EQUOTIP unit is now ready for operation.

14.2 Explanation of Remaining Function Keys

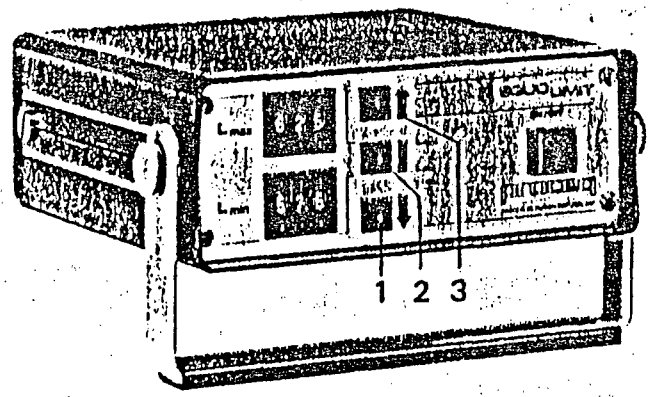
Key 7: CLEAR key for obviously erroneous measurements. The value erased will not be included in calculating the mean value.

Key 8: Permits performance check on the standard test block during a test series. (Test series = any number of mean values, each of which is based on several individual measurements.)
Preselected programs (switches 2, 3, 4) are disabled. Terminate performance test by depressing END key 6. During test block checks, control lamp 9 lights up.

Technical Specifications

Power supply:	Mains: 220 V AC ±10%, 50/60 Hz Rechargeable battery pack, operating time approx. 3 hours Recharging time approx. 6 hours Voltage drop indicated by blinking of "POWER ON" lamp Fuse (in socket): T 0.2 A
Ambient temperatures:	0°C to +50°C
Paper:	Electro-sensitive metal paper width: 60 mm length of roll approx. 30 m

15. EQUOlimit



The EQUOlimit is designed for:

a) direct connection to the EQUOTIP indicator device. Each individual measurement is evaluated.

b) connection to the EQUOprinter. Depending on the setting of selector 4 at the EQUOprinter, evaluation is performed either for each individual measurement (position "MAN") or the mean value (positions 3, 4, 5, etc.). When depressing key 8 (TEST BLOCK CHECK) on the EQUOprinter, subsequent control measurements are not evaluated by the EQUOlimit.

1 Lights up when the measurement falls below of the lower limit value L_{min}. Simultaneously, an acoustical signal is released.

2 Lights up when the measurement falls within the range given by L_{min} and L_{max}.

3 Lights up when the measurement exceeds the upper limit value L_{max}. Simultaneously, an acoustical signal is released.

A multi-point plug connector is available to deal with external control functions (acoustic signals, actuation of relays). This permits such operations as controlling sorting appliances, marking devices and the like.

Technical Specifications

Output: Switching relay: too high – normal – too low (potential-free contact)

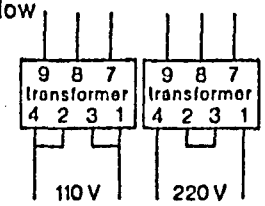
One-shot function with 100 ms impulse duration

AC switching power: max. 250 V, 4 A, 100 VA

DC switching power: max. 50 V, 4 A, 60 W

Acoustic signal can be muted

Power supply: 110/220 V AC, 50/60 Hz



ATTACHMENT 3.2

Hardness Conversion Tables Between

L_D Values and Brinell (for steel)

L_D Values and Vickers (for steel)

L_D Values and Rockwell C (for steel)

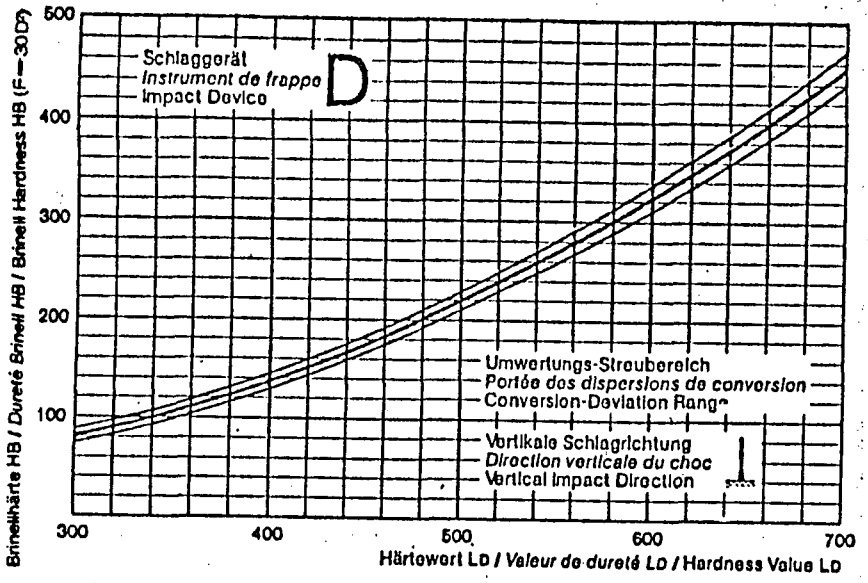
L_D Values and Shore D (for steel)

L_D Values and Brinell (for cast AL)

S[illegible]und Stahlguss
Acier et fonte d'acier
Steel and cast steel

(E-Modul 210 000 N/mm²)

LD - Brinell



Korrektur bei anderen Schlagrichtungen *Corrections pour des chocs en d'autres directions* Correction for other impact directions	LD	*	*	*	*
	300				
	350	6	12	20	29
	400	6	12	19	27
	450	5	11	18	25
	500	5	10	17	24
	550	5	10	16	22
	600	4	9	15	20
	650	4	8	14	19
	700	4	8	13	18

* Korrekturwerte sind vom gemessenen L-Wert abzuziehen
* *Corrections à déduire de la valeur L mesurée*
* Corrections to subtract from measured L-value

LD	HB (F=30D²)	±HB*
300	80	
302	81	
304	81	
306	82	
308	83	
310	84	
312	85	
314	86	
316	87	
318	88	
320	90	
322	91	
324	92	
326	93	
328	94	
330	95	
332	96	
334	97	
336	98	
338	99	
340	100	
342	101	
344	103	
346	104	
348	105	
350	106	10
352	107	
354	108	
356	110	
358	111	
360	112	
362	113	
364	115	
366	116	
368	117	
370	118	
372	120	
374	121	
376	122	
378	123	
380	125	
382	126	
384	127	
386	129	
388	130	
390	131	
392	133	
394	134	
396	136	
398	137	
400	138	

LD	HB (F=30D²)	±HB*
400	138	
402	140	
404	141	
406	143	
408	144	
410	145	
412	147	
414	148	
416	150	
418	151	
420	153	
422	154	
424	156	
426	157	
428	159	
430	160	
432	162	
434	164	
436	165	
438	167	
440	168	
442	170	
444	172	
446	173	
448	175	
450	176	13
452	178	
454	180	
456	181	
458	183	
460	185	
462	186	
464	188	
466	190	
468	192	
470	193	
472	195	
474	197	
476	199	
478	200	
480	202	
482	204	
484	206	
486	208	
488	209	
490	211	
492	213	
494	215	
496	217	
498	219	
500	221	

LD	HB (F=30D²)	±HB*
500	221	
502	222	
504	224	
506	226	
508	228	
510	230	
512	232	
514	234	
516	236	
518	238	
520	240	
522	242	
524	244	
526	246	
528	248	
530	250	
532	252	
534	254	
536	256	
538	258	
540	260	
542	262	
544	264	
546	267	
548	269	
550	271	16
552	273	
554	275	
556	277	
558	279	
560	281	
562	284	
564	286	
566	288	
568	290	
570	292	
572	295	
574	297	
576	299	
578	301	
580	304	
582	306	
584	308	
586	311	
588	313	
590	315	
592	317	
594	320	
596	322	
598	324	
600	327	

LD	HB (F=30D²)	±HB*
600	327	
602	329	
604	332	
606	334	
608	336	
610	339	
612	341	
614	344	
616	346	
618	348	
620	351	
622	353	
624	356	
626	358	
628	361	
630	363	
632	366	
634	368	
636	371	
638	373	
640	376	
642	378	
644	381	
646	383	
648	386	
650	389	20
652	391	
654	394	
656	396	
658	399	
660	402	
662	404	
664	407	
666	409	
668	412	
670	415	
672	417	
674	420	
676	423	
678	425	
680	428	
682	431	
684	434	
686	436	
688	439	
690	442	
692	444	
694	447	
696	450	
698	453	
700	456	

* Umwertungs-Streuung des Tabellenwertes im Vergleich zu direkter Brinellprüfung
* *Dispersion de conversion de la valeur du tableau en comparaison avec l'essai direct d'après Brinell*
* Conversion-Deviation of the Table value in comparison to direct Brinell Hardness testing

Die Werte sind gültig für unlegierten und niedriglegierten Stahl und Stahlguss im warmgewalzten oder geschmiedeten und wärmebehandelten Zustand.

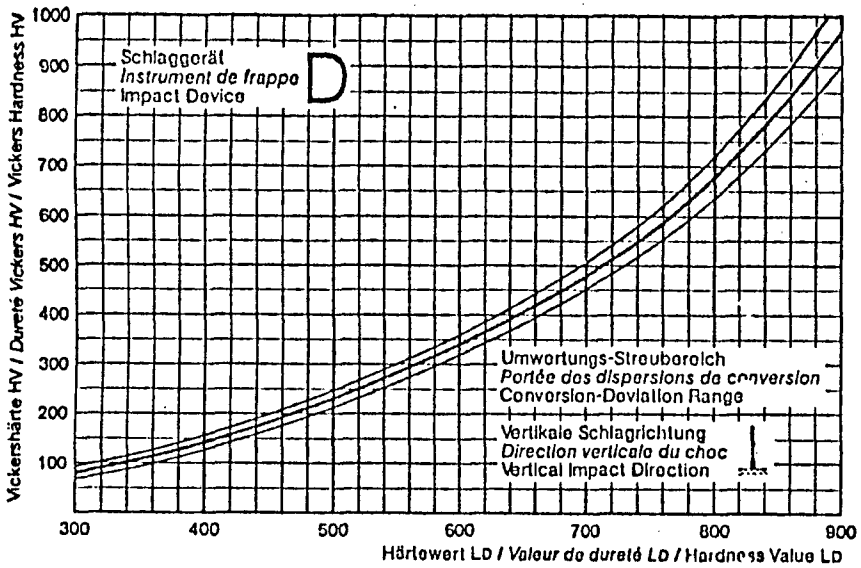
Les valeurs sont valables pour les aciers et les fontes d'acier non-alliés et faiblement alliés, forgés ou laminés à chaud et ayant subi un traitement thermique.

The values are valid for unalloyed and low alloy steel and cast steel in hot rolled or forged and thermally treated condition.

Stahl und Stahlguss
Acier et fonte d'acier
Steel and cast steel

(E-Modul 210 000 N/mm²)

LD - Vickers



Die Werte sind gültig für unlegierten und niedriglegierten Stahl und Stahlguss im warmgewalzten oder geschmiedeten und wärmebehandelten Zustand.
Les valeurs sont valables pour les aciers et les fontes d'acier non-alliés et faiblement alliés, forgés ou laminés à chaud et ayant subi un traitement thermique.
The values are valid for unalloyed and low alloy steel and cast steel in hot rolled or forged and thermally treated condition.

Korrektur bei anderen Schlagrichtungen
Corrections pour des chocs en d'autres directions
Correction for other impact directions

LD				
300	8	12	20	29
350	6	12	19	27
400	5	11	18	25
450	5	10	17	24
500	5	10	16	22
550	4	9	15	20
600	4	8	14	19
650	4	8	13	18
700	3	7	12	17
750	3	6	11	16
800	3	6	10	15
850	2	5	9	14
900				

• Korrekturwerte sind vom gemessenen L-Wert abzuziehen
• *Corrections à déduire de la valeur L mesurée*
• Corrections to subtract from measured L-value

• Umwertungs-Streuung des Tabellenwertes im Vergleich zu direkter Vickers-prüfung
• *Dispersion de conversion de la valeur du tableau en comparaison avec l'essai direct d'après Vickers*
• Conversion-Deviation of the Table value in comparison to direct Vickers Hardness testing

LD	HV	±HV*
300	80	
302	81	
304	82	
306	83	
308	84	
310	85	
312	86	
314	87	
316	88	
318	89	
320	90	
322	91	
324	92	
326	93	
328	94	
330	95	
332	96	
334	97	
336	98	
338	100	
340	101	
342	102	
344	103	
346	104	
348	106	10
350	107	
352	108	
354	109	
356	111	
358	112	
360	113	
362	115	
364	116	
366	117	
368	119	
370	120	
372	121	
374	123	
376	124	
378	126	
380	127	
382	128	
384	130	
386	131	
388	133	
390	134	
392	136	
394	137	
396	139	
398	140	
400	142	
402	143	
404	145	
406	147	
408	148	
410	150	
412	151	
414	153	
416	155	
418	156	
420	158	
422	159	
424	161	13
426	163	
428	164	
430	166	
432	168	
434	170	
436	171	
438	173	
440	175	
442	176	
444	178	
446	180	
448	182	
450	183	

LD	HV	±HV*
450	183	
452	185	
454	187	
456	189	
458	191	
460	192	
462	194	
464	196	
466	198	
468	200	
470	201	
472	203	
474	205	13
476	207	
478	209	
480	211	
482	213	
484	215	
486	216	
488	218	
490	220	
492	222	
494	224	
496	226	
498	228	
500	230	
502	232	
504	234	
506	236	
508	238	
510	240	
512	242	
514	244	
516	246	
518	248	
520	250	
522	252	
524	254	
526	256	
528	258	
530	260	
532	263	
534	265	
536	267	
538	269	
540	271	
542	273	
544	275	
546	277	
548	280	16
550	282	
552	284	
554	286	
556	288	
558	291	
560	293	
562	295	
564	297	
566	299	
568	302	
570	304	
572	306	
574	309	
576	311	
578	313	
580	315	
582	318	
584	320	
586	322	
588	325	
590	327	
592	330	
594	332	
596	334	
598	337	
600	339	

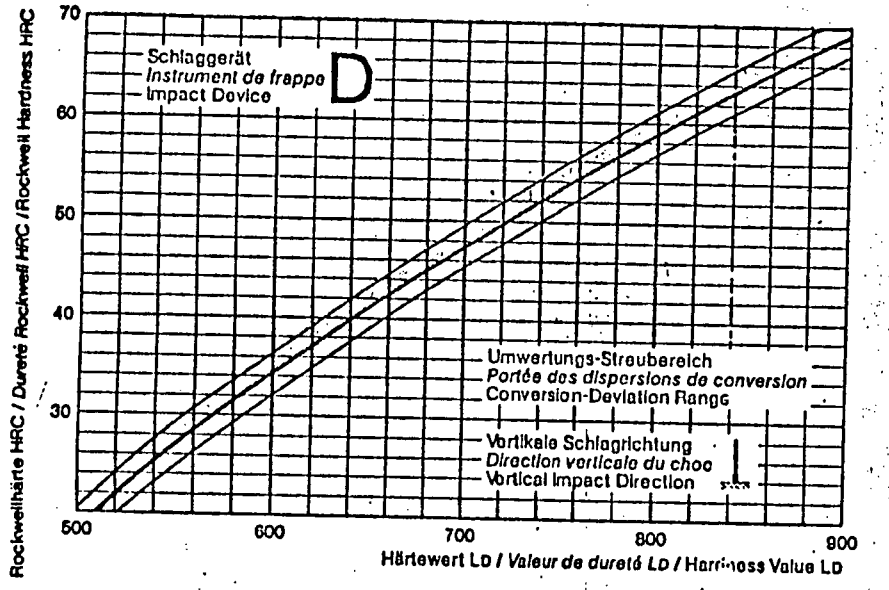
LD	HV	±HV*
600	339	
602	342	
604	344	
606	347	
608	349	
610	352	
612	354	
614	357	
616	359	
618	362	
620	364	
622	367	
624	369	
626	372	
628	375	
630	377	
632	380	
634	383	
636	385	
638	388	
640	391	
642	393	
644	396	
646	399	
648	402	20
650	404	
652	407	
654	410	
656	413	
658	416	
660	419	
662	421	
664	424	
666	427	
668	430	
670	433	
672	436	
674	439	
676	442	
678	445	
680	448	
682	451	
684	454	
686	458	
688	461	
690	464	
692	467	
694	470	
696	473	
698	477	
700	480	
702	483	
704	487	
706	490	
708	493	
710	497	
712	500	
714	503	
716	507	
718	510	
720	514	
722	517	
724	521	30
726	525	
728	528	
730	532	
732	535	
734	539	
736	543	
738	547	
740	550	
742	554	
744	558	
746	562	
748	566	
750	570	

LD	HV	±HV*
750	570	
752	574	
754	577	
756	581	
758	586	
760	590	
762	594	
764	598	
766	602	
768	606	
770	610	
772	615	
774	619	30
776	623	
778	628	
780	632	
782	636	
784	641	
786	645	
788	650	
790	655	
792	659	
794	664	
796	669	
798	673	
800	678	
802	683	
804	688	
806	693	
808	698	
810	703	
812	708	
814	713	
816	718	
818	723	
820	728	
822	733	
824	738	
826	744	
828	749	
830	755	
832	760	
834	765	
836	771	
838	777	
840	782	
842	788	
844	794	50
846	799	
848	805	
850	811	
852	817	
854	823	
856	829	
858	835	
860	841	
862	847	
864	854	
866	860	
868	866	
870	873	
872	879	
874	886	
876	892	
878	899	
880	905	
882	912	
884	919	
886	926	
888	933	
890	940	

[illegible] und Stahlguss
Acier et fonte d'acier
Steel and cast steel

(E-Modul 210 000 N/mm²)

LD - Rockwell C



Korrektur bei anderen Schlagrichtungen *Corrections pour des chocs en d'autres directions* Correction for other impact directions • Korrekturwerte sind vom gemessenen L-Wert abzuziehen • *Corrections à déduire de la valeur L mesurée* • Corrections to subtract from measured L-value	LD	*	*	*	*
	500				
	550	5	10	16	22
	600	4	9	15	20
	650	4	8	14	19
	700	4	8	13	18
	750	3	7	12	17
	800	3	6	11	16
	850	3	6	10	15
	900	2	5	9	14

LD	HRC	±HRC*
510	20,0	
512	20,4	
514	20,7	
516	21,0	
518	21,4	
520	21,7	
522	22,1	
524	22,4	
526	22,7	
528	23,1	
530	23,4	
532	23,7	
534	24,1	
536	24,4	
538	24,7	
540	25,0	
542	25,4	
544	25,7	
546	26,0	
548	26,3	
550	26,6	2
552	26,9	
554	27,3	
556	27,6	
558	27,9	
560	28,2	
562	28,5	
564	28,8	
566	29,1	
568	29,4	
570	29,7	
572	30,0	
574	30,4	
576	30,7	
578	31,0	
580	31,3	
582	31,6	
584	31,9	
586	32,1	
588	32,4	
590	32,7	
592	33,0	
594	33,3	
596	33,6	
598	33,9	
600	34,2	

LD	HRC	±HRC*
600	34,2	
602	34,5	
604	34,8	
606	35,1	
608	35,3	
610	35,6	
612	35,9	
614	36,2	
616	36,5	
618	36,7	
620	37,0	
622	37,3	
624	37,6	
626	37,9	
628	38,1	
630	38,4	
632	38,7	
634	38,9	
636	39,2	
638	39,5	
640	39,8	
642	40,0	
644	40,3	
646	40,6	
648	40,8	
650	41,1	2
652	41,4	
654	41,6	
656	41,9	
658	42,1	
660	42,4	
662	42,7	
664	42,9	
666	43,2	
668	43,4	
670	43,7	
672	43,9	
674	44,2	
676	44,4	
678	44,7	
680	45,0	
682	45,2	
684	45,5	
686	45,7	
688	46,0	
690	46,2	
692	46,4	
694	46,7	
696	46,9	
698	47,2	
700	47,4	

LD	HRC	±HRC*
700	47,4	
702	47,7	
704	47,9	
706	48,2	
708	48,4	
710	48,6	
712	48,9	
714	49,1	
716	49,4	
718	49,6	
720	49,8	
722	50,1	
724	50,3	
726	50,5	
728	50,8	
730	51,0	
732	51,2	
734	51,5	
736	51,7	
738	51,9	
740	52,2	
742	52,4	
744	52,6	
746	52,9	
748	53,1	
750	53,3	2
752	53,5	
754	53,8	
756	54,0	
758	54,2	
760	54,4	
762	54,7	
764	54,9	
766	55,1	
768	55,3	
770	55,6	
772	55,8	
774	56,0	
776	56,2	
778	56,4	
780	56,7	
782	56,9	
784	57,1	
786	57,3	
788	57,5	
790	57,7	
792	58,0	
794	58,2	
796	58,4	
798	58,6	
800	58,8	

LD	HRC	±HRC*
800	58,8	
802	59,0	
804	59,2	
806	59,5	
808	59,7	
810	59,9	
812	60,1	
814	60,3	
816	60,5	
818	60,7	
820	60,9	
822	61,1	
824	61,4	
826	61,6	
828	61,8	
830	62,0	
832	62,2	
834	62,4	
836	62,6	
838	62,8	
840	63,0	
842	63,2	
844	63,4	
846	63,6	
848	63,8	
850	64,0	2
852	64,2	
854	64,4	
856	64,6	
858	64,8	
860	65,0	
862	65,3	
864	65,5	
866	65,7	
868	65,9	
870	66,1	
872	66,3	
874	66,5	
876	66,7	
878	66,9	
880	67,1	
882	67,3	
884	67,4	
886	67,6	
888	67,8	
890	68,0	

* Umwertungs-Streuung des Tabellenwertes im Vergleich zu direkter Rockwell-Prüfung

* *Dispersion de conversion de la valeur du tableau en comparaison avec l'essai direct d'après Rockwell*

* Conversion-Deviation of the Table value in comparison to direct Rockwell Hardness testing

Die Werte sind gültig für unlegierten und niedriglegierten Stahl und Stahlguss im warmgewalzten oder geschmiedeten und wärmebehandelten Zustand.

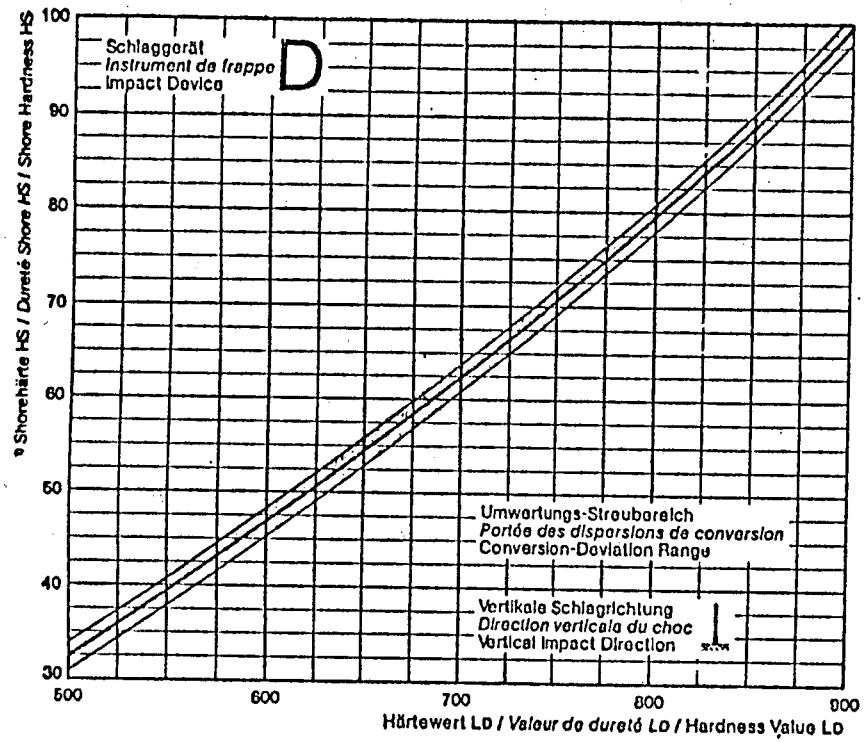
Les valeurs sont valables pour les aciers et les fontes d'acier non-alliés et faiblement alliés, forgés ou laminés à chaud et ayant subi un traitement thermique.

The values are valid for unalloyed and low alloy steel and cast steel in hot rolled or forged and thermally treated condition.

und Stahlguss
et fonte d'acier
Steel and cast steel

(E-Modul 210 000 N/mm²)

LD - Shore D[1]



[1]) Siehe letzte Seite
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Korrektur bei anderen Schlagrichtungen *Corrections pour des chocs en d'autres directions* Correction for other impact directions	LD	*	*	*	*
	500				
	550	5	10	16	22
	600	4	9	15	20
	650	4	8	14	19
	700	4	8	13	18
	750	3	7	12	17
	800	3	6	11	16
	850	3	6	10	15
	900	2	5	9	14

* Korrekturwerte sind vom gemessenen L-Wert abzuziehen
* *Corrections à déduire de la valeur L mesurée*
* Corrections to subtract from measured L-value

LD	[1]) HS	±HS*
500	32,5	
502	32,8	
504	33,1	
506	33,3	
508	33,6	
510	33,9	
512	34,2	
514	34,5	
516	34,7	
518	35,0	
520	35,3	
522	35,6	
524	35,9	
526	36,2	
528	36,4	
530	36,7	
532	37,0	
534	37,3	
536	37,6	
538	37,[illegible]	
540	38,2	
542	38,5	
544	38,7	
546	39,0	
548	39,3	
550	39,6	1,5
552	39,9	
554	40,2	
556	40,5	
558	40,8	
560	41,1	
562	41,4	
564	41,7	
566	42,0	
568	42,2	
570	42,5	
572	42,8	
574	43,1	
576	43,4	
578	43,7	
580	44,0	
582	44,3	
584	44,3	
586	44,9	
588	45,2	
590	45,5	
592	45,8	
594	46,1	
596	46,4	
598	46,7	
600	47,0	

LD	[1]) HS	±HS*
600	47,0	
602	47,3	
604	47,6	
606	47,9	
608	48,2	
610	48,5	
612	48,8	
614	49,1	
616	49,4	
618	49,7	
620	50,0	
622	50,3	
624	50,6	
626	50,9	
628	51,2	
630	51,5	
632	51,8	
634	52,2	
636	52,5	
638	52,8	
640	53,1	
642	53,4	
644	53,7	
646	54,0	
648	54,3	
650	54,6	1,5
652	54,9	
654	55,2	
656	55,5	
658	55,9	
660	56,2	
662	56,5	
664	56,8	
666	57,1	
668	57,4	
670	57,7	
672	58,0	
674	58,4	
676	58,7	
678	59,0	
680	59,3	
682	59,6	
684	59,9	
686	60,3	
688	60,6	
690	60,9	
692	61,2	
694	61,5	
696	61,9	
698	62,2	
700	62,5	

LD	[1]) HS	±HS*
700	62,5	
702	62,8	
704	63,1	
706	63,5	
708	63,8	
710	64,1	
712	64,4	
714	64,8	
716	65,1	
718	65,4	
720	65,7	
722	66,1	
724	66,4	
726	66,7	
728	67,1	
730	67,4	
732	67,7	
734	68,1	
736	68,4	
738	68,7	
740	69,1	
742	69,4	
744	69,7	
746	70,1	
748	70,4	
750	70,7	1,5
752	71,1	
754	71,4	
756	71,8	
758	72,1	
760	72,4	
762	72,8	
764	73,1	
766	73,5	
768	73,8	
770	74,2	
772	74,5	
774	74,9	
776	75,2	
778	75,6	
780	75,9	
782	76,3	
784	76,6	
786	77,0	
788	77,3	
790	77,7	
792	78,1	
794	78,4	
796	78,8	
798	79,1	
800	79,5	

	[1]) HS	±HS*
800	79,5	
802	79,9	
804	80,2	
806	80,6	
808	81,0	
810	81,3	
812	81,7	
814	82,1	
816	82,4	
818	82,8	
820	83,2	
822	83,6	
824	83,9	
826	84,3	
828	84,7	
830	85,1	
832	85,5	
834	85,9	
836	86,2	
838	86,6	
840	87,0	
842	87,4	
844	87,8	
846	88,2	
848	88,6	
850	89,0	1,5
852	89,4	
854	89,8	
856	90,2	
858	90,6	
860	91,0	
862	91,4	
864	91,8	
866	92,2	
868	92,6	
870	93,1	
872	93,5	
874	93,9	
876	94,3	
878	94,7	
880	95,2	
882	95,6	
884	96,0	
886	96,4	
888	96,9	
890	97,3	
892	97,7	
894	98,2	
896	98,6	
898	99,1	
900	99,5	

* Umwertungs-Streuung des Tabellenwertes im Vergleich zu direkter Shoreprüfung
* *Dispersion de conversion de la valeur du tableau en comparaison avec l'essai direct d'après Shore*
* Conversion-Deviation of the Table value in comparison to direct Shore Hardness testing

[1]) Siehe letzte Seite
[1]) *Voir en dernière page*
[1]) See last page

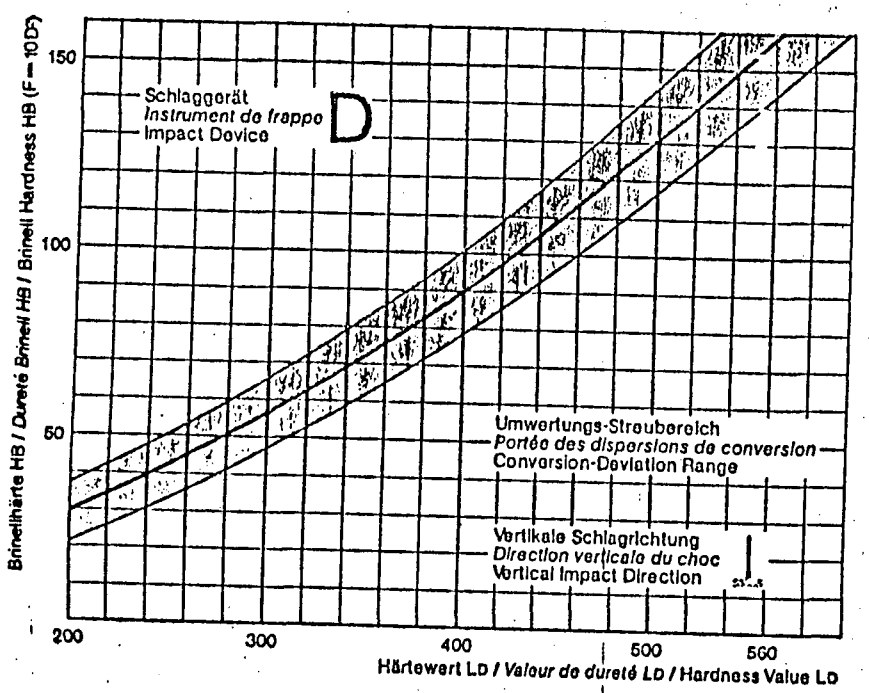
Die Werte sind gültig für unlegierten und niedriglegierten Stahl und Stahlguss im warmgewalzten oder geschmiedeten und wärmebehandelten Zustand.

Les valeurs sont valables pour les aciers et les fontes d'acier non-alliés et faiblement alliés, forgés ou laminés à chaud et ayant subi un traitement thermique.

The values are valid for unalloyed and low alloy steel and cast steel in hot rolled or forged and thermally treated condition.

Alu[illegible]m Gusslegierungen
Allia[illegible]d'aluminium pour fonderie
Cast Aluminium Alloys (E-Modul 65 000 – 85 000 N/mm²)

LD - Brinell



Korrektur bei anderen Schlagrichtungen *Corrections pour des chocs en d'autres directions* Correction for other impact directions • Korrekturwerte sind vom gemessenen L-Wert abzuziehen • *Corrections à déduire de la valeur L mesurée* • Corrections to subtract from measured L-value	LD	↘*	→*	↗*	↑*
	200				
	250	7	14	23	33
	300	6	13	22	31
	350	6	12	20	29
	400	6	12	19	27
	450	5	11	18	25
	500	5	10	17	24
	560	5	10	16	22

LD	HB (F=100²)	±HB*
200	30	
202	31	
204	31	
206	32	
208	32	
210	33	
212	33	
214	34	
216	34	
218	34	
220	35	
222	35	
224	36	
226	36	
228	37	
230	37	
232	38	
234	38	
236	39	
238	39	
240	40	
242	40	
244	41	
246	41	
248	42	
250	42	9
252	43	
254	43	
256	44	
258	44	
260	45	
262	46	
264	46	
266	47	
268	47	
270	48	
272	48	
274	49	
276	49	
278	50	
280	51	
282	51	
284	52	
286	52	
288	53	
290	54	
292	54	
294	55	
296	55	
298	56	
300	56	

LD	HB (F=100²)	±HB*
300	56	
302	57	
304	58	
306	58	
308	59	
310	60	
312	60	
314	61	
316	61	
318	62	
320	63	
322	63	
324	64	
326	65	
328	65	
330	66	
332	67	
334	67	
336	68	
338	69	
340	69	
342	70	
344	71	
346	71	
348	72	
350	73	10
352	73	
354	74	
356	75	
358	75	
360	76	
362	77	
364	77	
366	78	
368	79	
370	79	
372	80	
374	81	
376	82	
378	82	
380	83	
382	84	
384	84	
386	85	
388	86	
390	87	
392	87	
394	88	
396	89	
398	90	
400	90	

LD	HB (F=100²)	±HB*
400	90	
402	91	
404	92	
406	93	
408	93	
410	94	
412	95	
414	96	
416	96	
418	97	
420	98	
422	99	
424	100	
426	100	
428	101	
430	102	
432	103	
434	103	
436	104	
438	105	
440	106	
442	107	
444	107	
446	108	
448	109	
450	110	12
452	111	
454	112	
456	112	
458	113	
460	114	
462	115	
464	116	
466	116	
468	117	
470	118	
472	119	
474	120	
476	121	
478	122	
480	122	
482	123	
484	124	
486	125	
488	126	
490	127	
492	128	
494	129	
496	129	
498	130	
500	131	

LD	HB (F=100²)	±HB*
500	131	
502	132	
504	133	
506	134	
508	135	
510	135	
512	136	
514	137	
516	138	
518	139	
520	140	
522	141	
524	142	
526	143	
528	144	
530	145	
532	145	
534	146	
536	147	
538	148	
540	149	
542	150	
544	151	
546	152	
548	153	
550	154	15
552	155	
554	156	
556	157	
558	158	
560	159	

• Umwertungs-Streuung des Tabellenwertes im Vergleich zu direkter Brinellprüfung

• *Dispersion de conversion de la valeur du tableau en comparaison avec l'essai direct d'après Brinell*

• Conversion-Deviation of the Table value in comparison to direct Brinell Hardness testing

Die Werte sind gültig für Aluminium-Gusslegierungen nach DIN 1725 in vergütetem und unvergütetem Zustand.

Les valeurs sont valables pour les alliages d'aluminium pour fonderie d'après DIN 1725 en état amélioré et non-amélioré.

The values are valid for cast aluminum alloys according to DIN 1725 in a non-heat-treated and a quenched and tempered condition.

ATTACHMENT 3.3

PAGE _____ OF _____

TENNESSEE VALLEY AUTHORITY

SINGLETON MATERIALS ENGINEERING LABORATORY

HARDNESS TEST REPORT

PROJECT:	DATE PERFORMED:
COMPONENT TYPE:	EQUOTIP S/N:

COMPONENT/PART IDENTIFICATION	HARDNESS READINGS (L_D) 1	2	3	AVERAGE HARDNESS (L_D)	MAXIMUM DEVIATION FROM AVERAGE	POSITION CORRECTION: POSITION	CORRECTION	CORRECTED HARDNESS (L_D)	HARDNESS CONVERTED TO * _____	REMARKS

* - BRINNEL, ROCKWELL C, etc.

CALIBRATION CHECK

	TIME	NO. 1	NO. 2	NO. 3	SAT/UNSAT
INITIAL					
SUBSEQUENT 1					
SUBSEQUENT 2					
SUBSEQUENT 3					

PERFORMED BY:	DATE:
REVIEWED BY:	DATE:

TENNESSEE VALLEY AUTHORITY

SINGLETON MATERIALS ENGINEERING LABORATORY

HARDNESS TEST REPORT

PROJECT: WATTS BAR NUCLEAR PLANT UNIT 1 | DATE PERFORMED: 5-2-85

COMPONENT TYPE: RHR Pump 1BB | EQUOTIP S/N: 37-0063

motor to Pump Bolts

COMPONENT/PART IDENTIFICATION	HARDNESS READINGS (LD) 1	2	3	AVERAGE HARDNESS (LD)	MAXIMUM DEVIATION FROM AVERAGE	POSITION CORRECTION: POSITION	CORRECTION	CORRECTED HARDNESS (LD)	HARDNESS CONVERTED TO *BRINELL	REMARKS
NE Bolt 1	465	467	471	467	4	T	16	457	177	
NE Bolt 2	477	482	475	478	4	⊣	10	468	192	
SE Bolt 3	502	503	496	500	4	⊣	10	490	211	
SW Bolt 4	496	489	492	492	4	⊣	10	482	204	
RHR Pump 1AA										
Motor To Pump Bolts										
NE Bolt 1	468	465	471	468	3	⊣	10	458	183	
NE Bolt 2	467	477	471	471	6	⊣	10	461	185	
SE Bolt 3	488	482	487	485	3	⊣	10	475	198	
SW Bolt 4	490	488	485	487	3	⊣	10	477	199	

* - BRINNEL, ROCKWELL C, etc.

CALIBRATION CHECK

	TIME	NO. 1	NO. 2	NO. 3	SAT/UNSAT
INITIAL	5:15pm	754	757	756	SAT
SUBSEQUENT 1	6:00pm	754	757	757	SAT
SUBSEQUENT 2					
SUBSEQUENT 3					

PERFORMED BY: Paul V. Guthrie, Jr. | DATE: 5-2-85

REVIEWED BY: Craig Cantrell | DATE: 5-10-85

TENNESSEE VALLEY AUTHORITY

SINGLETON MATERIALS ENGINEERING LABORATORY

HARDNESS TEST REPORT

PROJECT: Watts BAR NUCLEAR PLANT unit 1 | DATE PERFORMED: 5-2-85

COMPONENT TYPE: Centrifugal Charging Pump | EQUOTIP S/N: 37-0063

COMPONENT/PART IDENTIFICATION	HARDNESS READINGS (LD) 1	2	3	AVERAGE HARDNESS (LD)	MAXIMUM DEVIATION FROM AVERAGE	POSITION CORRECTION: POSITION	CORRECTION	CORRECTED HARDNESS (LD)	HARDNESS CONVERTED TO * BRINELL	REMARKS
Speed Reducer unit (Gear Box) - 1BB										
NE Bolt 1	534	539	541	538	4	⊥	0	538	258	retested values
SE Bolt 2	528	527	534	529	5	⊥	0	529	249	
motor Bolts - 1BB										
NE Bolt 1	541	540	532	538	6	⊣	10	528	248	retested values
SE Bolt 2	552	560	555	555	5	⊣	10	545	265	
Speed Reducer unit (Gear Box) - 1AA										
NW Bolt 1	549	548	548	548	1	⊥	0	548	269	
This Bolt marked		Cold C forged				others marked		Δ		
motor Bolts - 1AA										
NW Bolt 1	517	524	524	521	4	⊣	10	511	231	
SW Bolt 2	545	535	536	539	6	⊣	10	529	249	
SE Bolt 3	515	516	513	514	2	⊣	10	504	224	

* - BRINNEL, ROCKWELL C, etc.

CALIBRATION CHECK

	TIME	NO. 1	NO. 2	NO. 3	SAT/UNSAT
INITIAL	6:45 pm	754	757	759	SAT
SUBSEQUENT 1					
SUBSEQUENT 2					
SUBSEQUENT 3					

PERFORMED BY: Paul V. Guthrie Jr. | DATE: 5-2-85

REVIEWED BY: Craig Cantrell | DATE: 5-10-85

ATTACHMENT 10 PAGE ____ OF ____

TENNESSEE VALLEY AUTHORITY

SINGLETON MATERIALS ENGINEERING LABORATORY

HARDNESS TEST REPORT

193 B7 = 125 KSI min

PROJECT: WATTS BAR NUCLEAR PLANT UNIT 1	DATE PERFORMED: 5-2-85
COMPONENT TYPE: Positive Displacement	EQUOTIP S/N: 37-0063

Charging Pump 1C - Motor Mounts (CVC Pump)

COMPONENT/PART IDENTIFICATION	HARDNESS READINGS (LD) 1	2	3	AVERAGE HARDNESS (LD)	MAXIMUM DEVIATION FROM AVERAGE	POSITION CORRECTION: POSITION	CORRECTION	CORRECTED HARDNESS (LD)	HARDNESS CONVERTED TO * Brinell	REMARKS
SW Bolt 1	560	553	555	556	4	↘	4	552	273	133,000 psi
SE Bolt 2	567	578	568	571	6	↘	4	567	289	142,000 psi

* - BRINNEL, ROCKWELL C, etc.

CALIBRATION CHECK

	TIME	NO. 1	NO. 2	NO. 3	SAT/UNSAT
INITIAL	7:15 pm	757	754	758	SAT
SUBSEQUENT 1					
SUBSEQUENT 2					
SUBSEQUENT 3					

PERFORMED BY: Paul V. Guthrie jr.	DATE: 5-2-85
REVIEWED BY: Craig Cantrell	DATE: 5-10-85

EQUIPMENT SPECIFICATION COVER SHEET
WESTINGHOUSE FORM 54064C

ATTACHMENT 11

Nuclear Energy Systems
P.O. Box 355
Pittsburgh, Pennsylvania 15230

EQUIPMENT SPECIFICATION	DATED	REVISION NO.	DATED	ORIGINAL ISSUE	SUPERSEDES PREVIOUS REVISIONS
G-952320	1/15/74	0	1/15/74	X	

PROJECT: GENERAL SPECIFICATION

EQUIPMENT: CLASS 2 RECIPROCATING POSITIVE DISPLACEMENT PUMPS BASED ON ASME BOILER & PRESSURE VESSEL CODE SECTION III - RULES FOR CONSTRUCTION OF NUCLEAR POWER PLANT COMPONENTS

SHOP ORDER: ANS SAFETY CLASS 2 AUXILIARY PUMPS 205

SYSTEM:

ATTACHMENTS

- QCS-1
- PWR SD Form 54823
- PS 292722
- E.Spec. 677474
- DRWG 271C900
- PS 83860 LA
- PS 85310 QA
- DN Form 54018C
- PS 80280 VM
- PS 84201 LH
- PS 84201 MW
- Pump Data Sheets

This document complies with Paragraph NA 3250 of the ASME Boiler and Pressure Vessel Code, Section III

Albert John Wertenberger 1/18/74
P.E. Date

COMMONWEALTH OF PENNSYLVANIA REGISTERED PROFESSIONAL ENGINEER ALBERT JOHN WERTENBERGER No. 15304

NOTE: Comments from the following groups have been received & resolved:
System Structural Analysis
Materials Engineering
Quality Assurance
Licensing
Reactor Fluid Systems

FOR SUPPLIER'S CONVENIENCE

REV. NO.	REVISION ENTERED BY & DATE

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APPROVALS

	ORIGINAL ISSUE	REV. 1	REV 2	REV 3	REV 4
AUTHOR	E. H. Brown E H Brown 1-18-74				
SHOP ORDER HOLDER	E. H. Brown E H Brown 1-18-74				
MANAGER, Auxiliary Equip.	E. J. Rusnica E J Rusnica 1/18/74				
PROJECT MANAGER					

4.2 Acceptable Materials

4.2.1 All material in contact with boric acid solution shall be stainless steel or an equivalent corrosion resistant material. The plunger stuffing box materials are excepted from the stainless steel requirement but these materials must be submitted to Ⓦ PWRSD for approval.

4.2.2 The following identified materials are acceptable to Ⓦ PWRSD for both pressure retaining and wetted parts. If the supplier prefers to use materials other than those specified, the materials in question must be submitted to Ⓦ PWRSD for review and approval prior to manufacture.

1. Stainless steel forgings shall conform to ASME SA-182, Grade F304 or F316.

2. Stainless steel plate shall conform to ASME SA-240, Type 304 or Type 316.

3. Stainless steel castings shall conform to ASME SA-351, Grade CF8 or CF8M.

4. Tubing shall conform to ASME SA-213, Grade TP 304L or TP 316L.

5. Bolting shall conform to ASME SA-193, Grade B7 or B8 with nuts to ASTM A-194, Class 2H or Grade 8.

6. Piping shall conform to ASME SA-312 (seamless) Grade TP 304L or Grade TP 316L.

7. Precipitation hardened Type 17-4PH stainless steel is permissible material for use in pump items. Type 17-4PH stainless steel used for pump applications shall be given an age hardening heat treatment of 1100°F or 1150°F.

a. Type 17-4PH stainless steel material used for highly stressed parts shall meet the requirements of ASME SA-564, Grade 630 with the following additional requirements:

(1) Samples cut from each heat of bar or forging stock for tensile, hardness and impact tests required in Table 4 shall be heat treated along with the material used for manufacture of pump parts. All properties listed in Table 4 of SA564 shall be met and reported in the certified test report. If the material is procurred fully heat treated from the Material Supplier, these samples may be removed from the material, e.g., bar, and tested and reported by the Material Supplier in his certified test report.

(2) In addition to the reporting of the results of chemical analysis, the mechanical tests required by (1) above & the compliance with all requirements of SA564 shall be reported in writing. It is mandatory that a furnace chart recording temperatures, including metal temp. be made when the age hardening heat treatment is performed, and be made available upon the request of Ⓦ. Thermocouples used during the age hardening treatment shall represent the max. and min. temperatures in the furnace.

b. Type 17-4PH stainless steel used in applications other than described in Paragraph 4.2.2.7a shall conform to either the requirements above in this specification or another specification approved by Ⓦ PWRSD for each application.

c. No welding shall be performed on 17-4PH stainless steels.

3 Additional Materials Requirements

4.3.1 When specified in the purchase order, high strength austenitic stainless steel bolting shall be used. Bolts and studs shall meet the requirements of ASME SA 453 Grade 660 (Code Case 1501) & nuts shall meet ASME SA 193 Grade 6 material (410) & requirements for nuts specified in ASME SA 194.

4.3.2 Apply a coating to all surfaces of all unpainted carbon steel bolts and nuts which shall consist of the following:

a. Manganese phosphate coating of PARCO-LUBE No. 2 (Parker Rust Proof Co., Parker Division of Hooker Chemical Co.) or Thermoil Granodine 112 (Amchem Products, Inc.).

b. This shall be followed by the application of a solid film lubricant (all graphite coating material) made by Electrofilm, Inc. This material is identified as LUBE-LOK #4006.

c. The resultant product shall be capable of withstanding a 48 hour salt spray test without having the bolts or nuts exhibit any evidence of corrosion.