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**Committee E28 on Mechanical Testing**
**Subcommittee E28.06 on Indentation Hardness Testing**

**Research Report: E28-1022**

# Interlaboratory Study to Establish Precision Statements of Rockwell Hardness Tests Made By Using Carbide Ball Indenters According to ASTM E18-01, Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

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## 1. Introduction:

This study was done in an effort to determine the normal variations that a user would expect to encounter while performing a variety of different scale Rockwell hardness tests. The study followed ASTM E 691-99 Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method. The statistics will define the range of readings one would expect within a given laboratory and between laboratories. Three of the most commonly used Rockwell test scales that use a spherical indenter, were included in the study.

## 2. Test Method:

The Test Method used for this ILS is E18-05, Standard Test Method for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials. To obtain a copy of E18, go to ASTM's website, www.astm.org, or contact ASTM Customer Service by phone at 610-832-9585 (8:30 a.m. - 4:30 p.m. Eastern U.S. Standard Time, Monday through Friday) or by email at service@astm.org.

## 3. Participating Laboratories:

The following laboratories participated in this interlaboratory study:

1. Wilson Instruments
Calibration Laboratory/
Instron Corporation
825 University Ave
Norwood, MA 02062
Mr. Edward Tobolski

2. David L. Ellis Company, Inc.
310 Old High Street
Acton, MA. 01720
Mr. Robert Ellis

3. Bodycote Thermal Processing
11C Old Right Road
Ipswich, MA. 01938
Mr. Fabio Montejo

4. Bodycote Thermal Processing
18600 Oxnard St.
Tarzana, CA. 91356
Mr Bob Lehnen

5. Sun-Tec Corporation
46590 Ryan Court
Novi, MI. 48377
Mr. Richard Antonik

6. SPS Technologies
301 Jenkintown Ave.
Jenkintown, PA. 19046
Mr. Michael Coladonato

7. Hayes Heat Treating
800 Wellington Ave
Warwick, RI. 02910
Mr. Richard Houghton, Jr.

8. Harris Steel Company
1223 South 55th Court
Cicero, IL. 60804
Mr. Herbert Koch

9. Sherry Laboratories
9301 Innovation Dr. Suite 175
Daleville, IN. 47334
Ms Debbie Frick

## 4. Description of Samples:

There were 3 samples of varying targeted results used for this study. Each sample was randomized and distributed by Ed Tobolski of Wilson Instruments. Below is a list of the samples with the corresponding supplier:

1. High Block
2. Medium Block
3. Low Block

## 5. Interlaboratory Study Instructions

Laboratory participants were emailed the test program instructions. Each laboratory was asked to perform Rockwell tests according to ASTM E18-05 on 9 test blocks that represented three hardness levels in each of three different Rockwell scales. They were instructed to perform three tests on each block in specific locations defined for each laboratory for a total of 27 tests. The labs were all instructed to make sure that only carbide balls are used. For a copy of the instructions, please see Attachment A.

## 6. Data Report Forms:

Each laboratory was provided with a data report form for the collection of data. A copy of each completed form is provided in Attachment C.

Please note: The laboratories have been randomly coded and cannot be identified herein.

## 7. Statistical Data Summary:

A summary of the statistics calculated from the data returned by the participating laboratories is provided in Attachment D.

## 8. Precision and Bias Statement:

The Research Reports is generated to support the Precision and Bias paragraph for ASTM E18 is provided in Attachment D.

# ATTACHMENT A

## INTRODUCTION

Laboratory # X
Xxxxx
Xxxxx
xxxxx

The E28.06 task group welcomes your participation in "The interlaboratory study (ILS) for Rockwell testing".

This study is being done to comply with the ASTM requirement for a precision statement in all test methods in terms of repeatability and reproducibility and will follow ASTM-E691- Standard Practice for conducting an interlaboratory study to determine the precision of a test method. The data generated will be used to prepare a precision statement in accordance with Practice E-177.

The testing and recording of the raw test data will be the responsibility of each participating independent laboratory. The analyzing of the data will be the responsibility of the task group and/or an appointed person familiar with the statistical procedures in this practice. The analysis utilizes tabular, graphical and statistical diagnostic tools for evaluating the consistency of the data so that unusual values may be detected and investigated, and also includes the calculation of the numerical measures of precision of the test method pertaining to both within-laboratory repeatability and between-laboratory reproducibility. The identity of the participating laboratories will be kept confidential.

It is expected that the results from this study will allow development of a revised precision statement for ASTM E18 that will reflect the use of carbide balls that are now standard. The previous study used steel balls only.

Nine test blocks and three different Rockwell scales will be used to generate the test data. The attached procedure requires that each lab perform three (3) tests on each block. This will result in a total of twenty-seven (27) tests for the entire study and should require approximately one and a half hours of time. **For all testing, testers and carbide ball indenters that meet the requirements of E18 must be used.** The table below lists the blocks that will be used in the study along with the test scales to be used for each block.

### Test Blocks Ranges And Scales Used In This Study are as follows:

Three Rockwell scales are included in this study, HRBW, HREW, and HR30TW. There will be a high, medium and low hardness block for each scale. Table 1 defines the **nominal hardness** values and the test parameters for each of the three scales.

# ATTACHMENT A

## Table 1

(Nominal Hardness values of Test Blocks and test parameters for each Rockwell Scale)

| Test Block Scale | Rockwell Hardness Scale & Nominal Hardness Value | | |
|---|---|---|---|
| | HRBW | HR30TW | HREW |
| High Block: | 95.0 | 79.0 | 100.0 |
| Medium Block | 60.0 | 56.0 | 81.0 |
| Low Block | 40.0 | 22.0 | 62.0 |
| Test parameters | 100kg,1/16 carbide ball | 30kg, 1/16 carbide ball | 100kg, 1/8 carbide ball |

Test Block Marking & Identification:

For identification, each test block has a stamped serial number and an ID number marked in red on the side of the block. This will help ensure that only the defined tests are performed on the correct test blocks. Table 2 defines the ID and serial numbers for each test block.

## Table 2

| ID Number Marked in red on side of Test Block | Test Block Serial Number Stamped on side of block | Hardness Scale and approximate level |
|---|---|---|
| 1 | 05G81585 | 95 HRB |
| 2 | 05G78031 | 60 HRB |
| 3 | 05G79409 | 40 HRB |
| 4 | 05A77932 | 79 HR30T |
| 5 | 05G78328 | 56 HR30T |
| 6 | 05G81257 | 22 HR30T |
| 7 | 05G85343 | 100 HRE |
| 8 | 05G85569 | 81 HRE |
| 9 | 05G82350 | 62 HRE |

Each laboratory is assigned three Test Areas on each block to be tested. The Test Areas are inside the red circles. Only one Rockwell test is to be performed inside each of the red circles. There will be a total of three tests performed on each block by each laboratory.

Attached is the data sheet to be used by your lab. Please make sure that all of the information required on the top of the sheet is filled out accurately and that a contact person is identified in case there is a need to discuss the results. At the completion of your testing, please promptly send all the test data and test blocks to Ed Tobolski at the address below.

Instron Corp.
Attn: Ed Tobolski
825 University Ave.
Norwood MA. 02062-2643
781-575-5840 Fax – 781- 575- 5770
Ed_tobolski@instron.com

# ATTACHMENT A

Thank you for your help on this project. Your efforts will help ASTM develop procedures that are useful to anyone performing Rockwell tests. At the end of the study you will be sent a spreadsheet with the results from all of the labs. Only their lab numbers will identify the participating labs.

**These test blocks have to be circulated to 9 different labs in a short period of time. Please make every effort to perform the testing quickly and return the information as requested. If you cannot perform the tests in a timely manor please contact Ed Tobolski immediately at 781-575-5840.**

## Test Procedure for E18 Rockwell ILS:

1. To minimize time dependant changes, if possible, please complete all testing within the same working day.

2. Enter all to the information required on the top of the Data sheet.

3. Test blocks should be handled in the same manner as you would any calibrated standard. Prior to testing, blocks should be cleaned with a clean soft cloth to remove any dirt or oil film from the top and bottom surfaces. Clean the bottom surface with solvent if necessary. Blocks should be held on the sides and not on the upper and lower surfaces. Do not sand, polish or work the top or the bottom surfaces of the blocks in any manner.

4 Make certain that your tester is performing according to the manufactures specification.

5 Select one of the 3 groups of high, medium & low scale test blocks.

6 Setup the tester for the correct scale to be tested per your normal procedure.

7 Select the correct indenter for the scale to be tested. **Make certain that the indenter has a carbide ball.**

8 Perform three seating tests on the scrap block provided.

9 On the first block, perform one test inside each of the three red circles on the block.

10 Record each test result on the attached data sheet to the nearest 0.1 Rockwell point, i.e. 60.3 HRBW.

11 Repeat steps 9 and 10 on the other two blocks of the same scale in the set provided.

12 Repeat steps 5 through 11 for the two remaining groups of test blocks.