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## NATIONAL BUREAU OF STANDARDS REPORT

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QUARTERLY REPORT

ON

EVALUATION OF REFRACTORY QUALITIES OF CONCRETE  
FOR JET AIRCRAFT WARM UP, POWER CHECK AND  
MAINTENANCE APRONS

by  
W. L. Pendergast, R. A. Clevenger, Emil Trattner



U. S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS

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## THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section is engaged in specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant reports and publications, appears on the inside of the back cover of this report.

**Electricity.** Resistance Measurements. Inductance and Capacitance. Electrical Instruments. Magnetic Measurements. Applied Electricity. Electrochemistry.

**Optics and Metrology.** Photometry and Colorimetry. Optical Instruments. Photographic Technology. Length. Gage.

**Heat and Power.** Temperature Measurements. Thermodynamics. Cryogenics. Engines and Lubrication. Engine Fuels. Cryogenic Engineering.

**Atomic and Radiation Physics.** Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Neutron Measurements. Infrared Spectroscopy. Nuclear Physics. Radioactivity. X-Rays. Betatron. Nucleonic Instrumentation. Radiological Equipment. Atomic Energy Commission Instruments Branch.

**Chemistry.** Organic Coatings. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Gas Chemistry. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

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**Building Technology.** Structural Engineering. Fire Protection. Heating and Air Conditioning. Floor, Roof, and Wall Coverings. Codes and Specifications.

**Applied Mathematics.** Numerical Analysis. Computation. Statistical Engineering. Machine Development.

**Electronics.** Engineering Electronics. Electron Tubes. Electronic Computers. Electronic Instrumentation.

**Radio Propagation.** Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services. Frequency Utilization Research. Tropospheric Propagation Research. High Frequency Standards. Microwave Standards.

**Ordnance Development.** These three divisions are engaged in a broad program of research and development in advanced ordnance. Activities include  
**Electromechanical Ordnance.** basic and applied research, engineering, pilot production, field testing, and evaluation of a wide variety of ordnance matériel. Special skills and facilities of other NBS divisions also contribute to this program. The activity is sponsored by the Department of Defense.  
**Ordnance Electronics.**

**Missile Development.** Missile research and development: engineering, dynamics, intelligence, instrumentation, evaluation. Combustion in jet engines. These activities are sponsored by the Department of Defense.

● Office of Basic Instrumentation

● Office of Weights and Measures.

# NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT

NBS REPORT

0903-21-4428

June 30, 1953

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QUARTERLY REPORT  
ON  
EVALUATION OF REFRACTORY QUALITIES OF CONCRETES  
FOR JET AIRCRAFT WARM UP, POWER CHECK, AND  
MAINTENANCE APRONS

by

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Refractories Section  
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Sponsored by  
U. S. Naval Civil Engineering Research and  
Evaluation Laboratory, Construction Battalion Center,  
Port Hueneme, California

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Approved:

R.A. Heindl, Chief,  
Refractories Section



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QUARTERLY REPORT  
ON  
EVALUATION OF REFRACTORY QUALITIES OF CONCRETES FOR JET AIR-  
CRAFT WARM UP, POWER CHECK, AND MAINTENANCE APRONS

Current Technical Requirements

1. All coarse aggregates shall be sieved and recombined to produce a gradation that will conform to BuDocks specification 45Ya [1] paragraph 2-05 for the 1 1/2 inch specified aggregate size. The aggregates shall be recombined in such percentages that the fineness moduli shall not vary more than plus or minus 0.2.

2. All fine aggregates shall be sieved and recombined so that the resulting gradation conforms to BuDocks 45Ya [1] paragraph 2-03. The aggregate shall be recombined to produce a fineness moduli of between 2.3 and 3.1 but for the aggregates now in use it shall not vary more than 0.2.

3. BuDocks 13Yd [2] (Table II) shall serve as a guide in arriving at the ratio of fine to coarse aggregates.

4. The upper limit for cement content shall be 7.5 bags per cubic yard of concrete. The lowest cement content concrete that develops the required flexural strength is desirable.



5. The concretes shall be mixed, specimens fabricated and cured in accordance with ASTM Designation C192-52T [3]. The curing treatment shall be 28-day fog room storage.

6. The air content of the concrete shall be limited to 4.5 plus or minus 1.5 percent. The air content shall be measured in accordance with ASTM Designation C231-52T [3].

7. The concrete must be of such a consistency as to yield a 2-inch slump when tested in accordance with ASTM Designation C143-52 [3c]. If, however, a concrete is not sufficiently workable this requirement may be modified.

8. The concrete must develop a flexural strength of 600-650 psi after 28-day fog room curing.

9. The compressive strength shall be determined on each concrete after the 28-day fog room curing period.

10. Resistance of the concrete to destruction when exposed to rapidly increasing and fluctuating temperatures is necessary.

11. Technical requirements 5, 7 are not applicable to Lunnite concretes. The recommendations of the manufacturer should be followed in mixing, placing, and curing these concretes.

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and allows for easy verification of the data.

Additionally, it is noted that regular audits are essential to identify any discrepancies or errors early on. This proactive approach helps in maintaining the integrity of the financial statements and prevents any potential issues from escalating.

The second section focuses on the role of technology in modern accounting. It highlights how software solutions have revolutionized the way businesses manage their finances. From automated data entry to real-time reporting, these tools significantly reduce the risk of human error and save valuable time.

However, it also points out that while technology offers many benefits, it is not a substitute for human oversight. Accountants must still exercise their professional judgment and ensure that the software is configured correctly to meet the specific needs of the business.

In conclusion, the document stresses that a combination of sound accounting practices and the effective use of technology is key to successful financial management. By adhering to these principles, businesses can ensure that their financial records are accurate, reliable, and compliant with all relevant regulations.

Finally, it is recommended that businesses should invest in ongoing training for their accounting staff to stay updated on the latest industry trends and technological advancements. This continuous learning is crucial for maintaining a competitive edge in today's dynamic market.



## I. INTRODUCTION

The objective of the investigation is the determination of certain physical properties of concretes that will evaluate their suitability for use in jet aircraft warm up, power check, and maintenance aprons.

## II. MATERIALS: PREPARATION AND TESTING

Cements. The specific gravity of the three cements used in designing the concretes follows. The determinations\* were made in accordance with ASTM Designation C188-44 [4].

<u>Identity</u>	<u>Specific Gravity</u>
North American Portland	3.11
Green Bag Portland Pozzolan	3.13
Universal Atlas Lumnite	3.09

Aggregates. Coarse and fine fractions of aggregate were selected to conform with the Specification for Portland Cement Concrete Pavement for Airports No. 45Ya Sept. 1952, and the technical requirements of NAVCEREIAB.

The screen sizes and percentage of each of the sizes resulting from such selection of the aggregates and which will be used in all future concretes are given in Table I.

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\* Made by the Concreting Materials Section, Mineral Products Division, National Bureau of Standards



Table I. Screen Sizes of Aggregates

Coarse Fractions		Fine Fractions	
Screen No.	Percentage Passing	Screen No.	Percentage Passing
1 1/2	100	4	100
1	78	8	85
3/4	48	16	68
1/2	30	30	50
3/8	15	50	21
No. 4	0	100	3

When aggregates are sized in accordance with the gradation given in Table I the fineness modulus of the coarse will be 7.37 and that of the fine 2.73.

One and one-half tons each of White Marsh gravel and White Marsh sand was screened to meet the gradation requirements. The ratio of gravel to sand in the concretes designed using this aggregate was 3.6 : 1.9 resulting in a combined fineness modulus of 5.74.

Bluestone, a second aggregate, is being screened as purchased. After screening one ton of this material the results indicate that additional crushing and screening will be necessary to obtain the proper yield of the required sizes.



Considerable work has been done to facilitate the selection of a brick for an aggregate. Tests were made on a low-grade fire brick and two dense face bricks. The brick chosen was a West Virginia hard face brick having a flexural strength of 2180 psi. This brick when crushed is angular in shape and the percentage yield of the desired sizes is reasonably satisfactory.

Properties of the three aggregates tested during this quarter for future use in designing concretes are as follows:

<u>Aggregate</u>	<u>Size</u>	Bulk specific gravity <u>S-S Dry</u>	Water absorption in percent <u>by weight</u>	Los Angeles abrasion percentage <u>wear</u>
White Marsh	gravel	2.64	0.30	40.5
	sand	2.63	0.30	
Bluestone	coarse	2.76	1.50	21.3
	fine	2.65	0.27	
West Virginia hard face	coarse	--	--	26.0
	fine	--	--	

Concretes. The properties of the fresh concretes are given in Table II. Three concretes were designed with White Marsh gravel and sand as the aggregate and either with

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. This is essential for ensuring the integrity of the financial statements and for providing a clear audit trail. The records should be kept up-to-date and should be easily accessible to all relevant parties.

2. The second part of the document outlines the various methods used to collect and analyze data. This includes the use of surveys, interviews, and focus groups. Each method has its own strengths and weaknesses, and it is important to choose the most appropriate one for the specific research objectives. The data collected should be analyzed carefully to identify any trends or patterns.

3. The third part of the document describes the results of the research. This includes a detailed analysis of the data and a discussion of the findings. The results show that there is a strong correlation between the variables studied, and that the findings have significant implications for the industry. The research also highlights some areas for further investigation.

4. The fourth part of the document provides a conclusion and a list of recommendations. The conclusion summarizes the main findings of the research and emphasizes the importance of the results. The recommendations are based on the findings and provide a clear path forward for the organization. It is recommended that the organization should implement the suggested changes to improve its performance.

5. The fifth part of the document contains a list of references and a list of appendices. The references list the sources used in the research, and the appendices provide additional information that is relevant to the study. The references include books, articles, and reports, and the appendices contain data tables and other supporting documents.

6. The sixth part of the document is a list of figures and tables. These provide a visual representation of the data and are essential for understanding the results of the research. The figures include line graphs, bar charts, and pie charts, and the tables contain numerical data. The figures and tables are clearly labeled and easy to interpret.

Table II. Properties of Fresh  $\frac{3}{4}$  Concrete

Laboratory identification $\frac{b}{c}$	Proportions by weight: Cement to coarse and to fine aggregate	Cement content Sacks per yd <sup>3</sup> of concrete	Water content Gals/yd <sup>3</sup> of concrete	Moist resin by weight of cement	Air content Gravimetric method	Air meter	Slump Inches	Weight of fresh concrete lbs/ft <sup>3</sup>	Water cement ratio	Flexural strength Psi	Remarks
P-4N-4	1 : 3.49 : 1.88	6.18	32.3	0.010	2.50	3.00	3.0	147.4	0.46		
P-4N-B	do	6.11	30.5	0.015	3.64	4.25	2.0	145.2	0.44		
P-4N-C	1 : 3.60 : 1.94	6.00	28.4	do	4.77	4.10	1.5	145.7	0.42		
P-4N-D	do	6.04	29.9	do	3.85	3.80	1.0	146.5	0.44		
P-4N-E	do	5.99	30.8	do	3.90	4.30	2.0	145.9	0.45		
2-4N-4	1 : 3.58 : 1.95	5.98	31.3	none	3.71	3.50	2.0	145.9	0.46		
L-4N-4	1 : 3.58 : 1.93	6.22	29.5	do	0.91	1.60	1.0	151.3	0.42		Harsh mix, dense concrete aggregate fracture approx. 75%
L-4N-B	1 : 3.58 : 1.93	5.69	28.4	0.050	8.60	over 8	2.0	138.5	0.44	395 $\frac{e}{f}$	Slightly honeycombed, aggregate fracture approx. 15%
L-4N-C	do	5.95	31.8	0.020	5.20	4.20	4.5	145.5	0.47	500 $\frac{d}{f}$	Good workability, dense concrete aggregate fracture approx. 15%
L-4N-D	do	6.03	29.8	0.015	3.10	3.40	2.0	147.2	0.44	505 $\frac{e}{f}$	Good workability, dense concrete aggregate fracture approx. 25%
L-4N-E	do	6.02	30.2	do	3.20	3.50	2.0	147.0	0.44	500 $\frac{d}{f}$	Good workability, dense concrete aggregate fracture approx. 50%
P-4N-1	1 : 3.57 : 1.95	5.85	32.3	do	5.30	5.12	1.5	142.9	0.47		
P-4N-2	do	5.81	32.1	do	5.97	6.10	2.0	142.0	0.47		
P-4N-3	do	5.87	32.4	do	4.96	5.60	1.5	143.5	0.47	540 $\frac{e}{f}$	Some air voids, aggregate fracture approx. 10%
2-4N-1	1 : 3.58 : 1.94	5.91	32.6	do	4.48	3.80	2.0	144.4	0.49	640 $\frac{e}{f}$	For pull outs, air voids near center, aggregate fracture approx. 5%
2-4N-2	do	5.96	33.0	do	3.54	3.40	2.5	145.9	0.49		
2-4N-3	do	5.98	33.0	do	3.38	3.20	2.0	146.1	0.49		
L-4N-1	1 : 3.58 : 1.93	5.98	30.8	do	4.00	3.30	3.5	145.5	0.46		
L-4N-2	do	5.98	31.8	do	3.40	2.70	1.0	145.9	0.47		
L-4N-3	do	5.98	31.6	do	3.45	3.50	4.5	145.9	0.47		

$\frac{a}{b}$  For convenience the flexural strength thus far determined of several of the concretes are included in the table.

$\frac{b}{c}$  P = Portland Cement; Z = Portland Pozzolan Cement;

L = Lumnite Cement; M = White Marsh gravel and sand

The last letters "N" to "E" inclusive, indicate final selected mix made in a 5-cubic foot mixer

Three batches of the selected mix were necessary to fabricate the required number of test specimens.

$\frac{e}{f}$  Put in fog room 1/2 hour after placing, cured 21 1/2 hours in fog room in mold, stripped and after 2 hours additional in fog room, tested.

$\frac{g}{h}$  Seven hours in laboratory in mold, stripped and put in fog room for 17 hours, then tested.

$\frac{i}{j}$  Cured for 28 days in fog room.





portland, portland pozzolan, or high alumina hydraulic cements. Trial batches of each concrete were mixed in a 1-cubic foot mixer. As a result of the information gained from these trial batches concrete was designed for fabricating the specimens for the complete series of tests. Five sets of test specimens of each concrete, requiring 3 five-cubic foot charges were fabricated and will be tested after curing and after one of four different heat exposures. Two sets have been cured in the fog room for 28 days, their flexural strengths determined, and are reported in Table II.

### III. DISCUSSION AND RESULTS

The results given in Table II indicate that the properties of the fresh concretes designed and mixed fall within the limits contained in NAVECEIAB letter of April 1, 1953. Only two of the concretes have completed the 28-day curing cycle and have been tested for flexural strength. The concrete designed using portland cement and White Marsh aggregate failed to meet the 600-650 psi flexural strength requirement. This concrete was designed using a 6 sack (per cubic yard of concrete) mix. It is planned to redesign the mix increasing the cement content to 6.5 - 7 sacks per cubic yard.



- [1]. Specification for Portland Cement Concrete Pavement for Airposts. Sept. 1952 Department of the Navy
- [2]. Specification for Concrete Construction June 1951 Department of the Navy
- [3]. ASTM Standards on Mineral Aggregates, Concrete and Non-bituminous Highway Materials.
- (a) Tentative Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory Page 147.
- (b) Tentative Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
- (c) Standard Method of Test for Slump of Portland-Cement Concrete Page 187.
- (d) Standard Page 165
- [4]. ASTM Standards on Cement (with related information) April 1952. Standard Method of Test for Specific Gravity of Hydraulic Cement.

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NOTE: One full time professional employee assigned to this project permanently transferred to another Division of this Bureau. The employee who replaced him resigned as of June 30. A third employee was appointed effective June 29.



ADDENDUM A  
Cooperative Tests

For the purpose of determining what variation might be expected in the results of tests of concretes fabricated at different laboratories, three concretes were designed, fabricated, cured, and tested at the U. S. Naval Civil Engineering Research and Evaluation Laboratory. Santa Clara sand and Colton Type I portland cement used in these three concretes were forwarded from that Laboratory to this Bureau during March. The results of tests made on the aggregates by the two laboratories were as follows:

<u>Laboratory</u>	<u>Material</u>	<u>Specific Gravity</u>	<u>Absorption</u>	<u>Fineness Modulus</u>
NAVCERELAB	sand	2.53	1.97	3.14
NBS	"	2.55	1.68	3.22
NAVCERELAB	gravel	2.53	2.78	6.85
NBS	"	2.51	2.98	7.06

The aggregates were brought to a saturated-surface dry condition. The designated amounts of gravel, cement, sand, and water were added in that order and mixed for 4 minutes. The slump and air content were determined and specimens fabricated.

The first part of the document discusses the importance of maintaining accurate records of all transactions. It is essential to ensure that every entry is properly documented and verified. This process helps in identifying any discrepancies or errors early on, preventing them from escalating into larger issues. Regular audits and reconciliations are key to maintaining the integrity of the financial data.

Furthermore, it is crucial to establish a clear system of internal controls. This involves defining roles and responsibilities, implementing segregation of duties, and ensuring that all personnel are adequately trained. A robust internal control system not only reduces the risk of fraud but also enhances the overall efficiency and reliability of the organization's operations.

In addition, transparency and communication are vital for success. Stakeholders should be kept informed about the company's financial performance and any potential risks. Regular reporting and open dialogue with investors, creditors, and other interested parties can build trust and confidence in the organization's management.

Finally, it is important to stay updated on the latest regulations and industry trends. The financial landscape is constantly evolving, and organizations must adapt to new requirements and challenges. Continuous learning and professional development are essential for staying ahead in a competitive market.

The properties of the fresh concrete are given in Table A. A sufficient number of 6 x 6-inch beams were fabricated to permit three breaks of each concrete after two different curing periods. The specimens after curing were tested for flexural and compressive strength. The results are given in Table B.

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NOTE: The above three concretes were designed, mixed, fabricated, cured, and tested at the National Bureau of Standards in accordance with instructions given in NAVCEREIAB letters of February 25 and May 11, 1953.





Table A. Properties of Fresh Concretes

Identification	Laboratory	Size of batch	Cement Content	Water	Slump	Aggregate		Sand	Unit weight of fresh concrete	Air Content	Water Cement ratio
						sand	d/gravel				
		cu. ft.	Sacks/yd <sup>3</sup>	Lbs/yd <sup>3</sup>	Inches	Lbs	Lbs	%	Lbs/ft <sup>2</sup>	%	%
C-SC-1	A	27.30	3.50	334	3.5	1730	1470	54.0	140.7	0.20	1.02
	B	27.33	3.46	341	2.0	1719	1475	53.8	141.3	0.20	1.05
C-SC-2	A	26.34	5.50	274	3.5	1475	1568	48.5	144.7	0.10	0.53
	B	26.28	5.64	273	2.5	1471	1570	48.6	144.4	0.10	0.52
C-SC-3	A	27.00	7.50	315	3.5	1300	1585	45.0	144.9	0.01	0.46
	B	26.97	7.52	315	7.0	1300	1594	45.0	145.2	0.01	0.45

a/ The letters C-SC denote Colton cement and Santa Clara gravel and sand aggregate  
 The numerals 1, 2, and 3 denote the cement content, namely, 3 1/2, 5 1/2, and 7 1/2 sacks/yd<sup>3</sup> of concrete

b/ A = NAVFREL-LAB; B = National Bureau of Standards

c/ The values tabulated for National Bureau of Standards (B) were calculated using batch weights and weight per cubic foot of fresh concrete

d/ Weight based on saturated-surface dry conditions

e/ The data furnished by NAVFREL-LAB for specific gravity and absorption were used in calculating volume; a value of 3.15 was used for specific gravity of Colton cement.



TABLE B. STRENGTH OF CURED CONCRETES

Identifi- cation <u>a/</u>	Labora- tory <u>b/</u>	Flexural Strength after curing		Compressive Strength <sup>c/</sup> after curing	
		7 & 21 days <u>d/</u>	28 days <u>e/</u>	7 & 21 days <u>d/</u>	28 days <u>e/</u>
		psi		psi	
C-SC-1	A		351		1450
	B	200	245	1455	1325
C-SC-2	A		625		4650
	B	425	540	4540	4340
C-SC-3	A		739		5380
	B	395	620	5070	4840

a/ The letters C-SC denote Colton cement and Santa Clara gravel and sand aggregate  
The numerals 1,2, and 3 denote the cement content, namely, 3 1/2, 5 1/2 and 7 1/2 sacks per yd<sup>3</sup> of concrete

b/ A = NAVCEREIAB; B = National Bureau of Standards

c/ The compressive strength results obtained at the NBS laboratory were determined on portions of the broken beams used for flexural strength tests

d/ Curing period: 7 days in fog room and 21 days storage in laboratory at prevailing temperatures and humidities

e/ 28 days in fog room

f/ ~~The variation expressed in percent is based on results obtained at NAVCEREIAB.~~



### DISCUSSION OF RESULTS

The values given in Table A for the properties of the fresh concretes as determined by the two laboratories compare favorably with one exception, namely, the slump for the concrete containing 7 1/2 bags of cement.

A comparison, however, of the strengths, Table B, of the three cured concretes (as determined by the two laboratories) indicates that the values determined at this Bureau are lower than those of NAVCERELAB. The flexural strengths of the concretes ranged from 14 to 30 percent lower and the compressive strengths approximately 10 percent lower.



ADDENDUM B

Experimental Concrete Mixes. A limited number of concrete mixes were designed in which changes were made in the cement to aggregate ratio, the fineness modulus of the fine aggregate, the method of placing, the curing time, and method of curing. The purpose of the work was to learn what could be accomplished in the laboratory that would result in increasing the flexural strength above that previously obtained of cured concretes. The results are given in the following table as a matter of record. In these experimental mixes the two cements used were portland (P) and Lumnite (L). The same aggregate, namely, White Marsh sand and gravel, was used in the mixes.





Experimental Concretes

Laboratory Identification	Proportion by weight of cement to fine to coarse	Fineness modulus of fine sand	Cement content	Air Content	Method and Time of Curing	Number of days of curing	Flexural Strength
PS-A1	1:2.3:3.3	2.82	5.6	2.8	24 hrs. in molds under burlap in fog room. 6 days in fog room out of molds.	7	420
PS-A2	1:2.3:3.3	2.82	5.6	2.8	24 hrs. in molds under burlap in fog room. 6 days in fog room out of molds. 21 days in laboratory air.	28	395
PS-A3	1:2.3:3.3	2.82	5.6	2.8	24 hrs. in molds under burlap in fog room. 27 days in fog room out of molds.	28	650
PS-B	1:1.6:2.3	2.82	8.0	3.6	Same as PS-A1 for comparison of strength with varying cement content	7	525
PS-C	1:1.6:2.3	3.10	7.8	5.5	Same as PS-B for comparison of strength with varying fineness modulus of fine sand	7	690
PS-XR	1:1.6:2.3	2.82	7.8	<u>a/</u>	4 hrs. in laboratory air in molds uncovered. 20 hrs. in fog room under burlap. 6 days in fog room out of molds	7	610
PS-XV	1:1.6:2.3	2.82	7.8	<u>a/</u>	Same as PS-XR but vibrated	7	660
LS-A1	1:1.2:2.3	2.82	6.3	5.4	Method & time of curing same as PS-A1	7	400
LS-A2	1:2.3:2.3	2.82	6.3	5.4	5 hrs. in molds in laboratory air, no burlap. 19 hrs in molds in fog room 6 days out of molds in fog room	7	425
LS-A3	1:2.3:2.3	2.82	6.3	5.4	24 hrs. in laboratory air (22 under burlap) 6 days in fog room out of molds	7	500

a/ Air content not determined. PS-XR and PS-XV fabricated from same batch.



## THE NATIONAL BUREAU OF STANDARDS

### Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

### Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards (\$1.00). Information on calibration services and fees can be found in NBS Circular 483, Testing by the National Bureau of Standards (25 cents). Both are available from the Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.

