

OPERATION BREAKTHROUGH, PROJECT LEAP, AND ASTM E541

Three Federal Sources: NBSIR 75-642 (1975) | NBS SP 473 (1977) | NBS SP 552 (1979)
A History of the Center for Building Technology's Housing Certification Programs, 1968–1975

Executive Summary

This history is drawn from three federal publications that document different stages of the same period of building-regulatory development.

NBSIR 75-642 (1975): Project Summaries of the Center for Building Technology. The contemporaneous project record places Operation Breakthrough, the Coordinated Evaluation System (CES), and Project LEAP within the Center's Standards and Codes program while the LEAP criteria were still moving through ASTM.

NBS Special Publication 473 (1977): Research and Innovation in the Building Regulatory Process. It publishes Otis M. Mader's September 1976 NIBS keynote, 'The National Institute of Building Sciences—A Progress Report,' describing the newly created NIBS, its proposed national role in performance criteria, evaluation and prequalification, and its still-unfinished startup status.

NBS Special Publication 552 (1979): Research and Innovation in the Building Regulatory Process. Gene A. Rowland's retrospective account supplies the fuller LEAP history: the 1970 NCSBCS request, LEAP's January 1971 launch, transfer of the LEAP reports to ASTM, and ASTM E541's 1975 consensus result.

Core Finding

Operation Breakthrough included Project LEAP and the standards-development work that produced ASTM E541. Operation Breakthrough addressed housing systems and producer evaluation. Project LEAP addressed the competence of the laboratories and agencies performing systems analysis, testing, inspection, and compliance assurance. NBS and NCSBCS transferred the LEAP research to ASTM, where Committee E32 produced ASTM E541 by consensus in 1975.

1. The Three Federal Publications

The three publications are not duplicates. They are sequential records. NBSIR 75-642 is a project-status publication from January 1975. SP 473 records the first NBS/NCSBCS joint conference and Mader's NIBS progress report from September 1976. SP 552 records the third annual conference and Rowland's 1978 retrospective, published in July 1979. Read together, they show what the federal government had built, what NIBS proposed to build next, and what became of the earlier LEAP work.

Federal publication	What it documents	Why it matters
NBSIR 75-642 (1975)	The Center for Building Technology project record: Operation Breakthrough, the Coordinated Evaluation System (CES), Project LEAP, testing, evaluation, certification, and standards work.	Shows the federal building-regulatory infrastructure while the work was still underway.
NBS Special Publication 473 (1977)	Proceedings of the First NBS/NCSBCS Joint Conference, including Otis M. Mader's 1976 keynote, "The National Institute of Building Sciences—A Progress Report."	Shows what the newly created NIBS said it intended to become: a national coordinating source for standards, evaluation, prequalification, information, and regulatory acceptance.

Federal publication	What it documents	Why it matters
NBS Special Publication 552 (1979)	Proceedings of the Third NBS/NCSBCS Joint Conference, including Gene A. Rowland's retrospective account of NBS/NCSBCS work.	Completes the LEAP history: 1970 request, January 1971 launch, four research reports, transfer to ASTM, and ASTM E541 consensus in 1975.

2. NBSIR 75-642 (1975): The Work in Progress

NBSIR 75-642, Project Summaries of the Center for Building Technology, National Bureau of Standards 1974–75, is the contemporaneous project record.

The Publication

Item	Description
Report number	NBSIR 75-642
Title	Project Summaries of the Center for Building Technology, National Bureau of Standards 1974–75
Issued	January 1975
Prepared by	Center for Building Technology, Institute for Applied Technology, National Bureau of Standards
Purpose	To summarize the Center's current building-technology projects, objectives, sponsors, project leaders, status, and expected results.

The publication is organized by the Center for Building Technology's major program areas. Its organizational chart identifies four offices under Center Headquarters: Building Standards and Codes Services, Housing Technology, Federal Building Technology, and Energy Conservation, with Technical Evaluation and Application shown separately as a division. The table of contents places CES, LEAP, and the Operation Breakthrough projects within the Standards and Codes section.

The Center for Building Technology

The Center for Building Technology functioned as a federal building-research and technical-coordination center. Its work included building standards, codes, housing technology, testing, evaluation, regulatory assistance, and the transfer of technical findings to government and industry.

Program	Role Shown in NBSIR 75-642
Standards and Codes	Identification of national building-standard needs, participation in consensus standards, and delivery of completed standards to code officials.
Housing Technology	Research directed toward critical housing needs, mobile-home research planning, and technical support for federal housing programs.
Federal Building Technology	Research assistance, technical guidance, standards review, and coordination among federal agencies involved in building construction.
Energy Conservation / Technical Evaluation and Application	Application of NBS research, testing, evaluation, and technical information to building-regulatory and industry needs.

Operation Breakthrough

Operation Breakthrough was HUD-sponsored work for the development, evaluation, demonstration, and documentation of industrialized housing systems. NBSIR 75-642 identifies several Center for Building Technology projects conducted in direct support of the program.

Operation Breakthrough Project	Documented Function
Building Concepts Used in Operation Breakthrough	Documented the building concepts and systems used in the program.
Breakthrough Housing Systems Producers Evaluation and Certification	Evaluated the technical systems and designs of the 22 housing-system producers participating in Phase I, using NBS and other laboratories and full-scale testing where required.
Compendium of Test Methods Used in Operation Breakthrough	Identified and documented laboratory test methods used in the evaluation of Operation Breakthrough systems.
Fire Compendium for Operation Breakthrough	Compiled the fire-related criteria, methods, and technical findings used in the program.
Shelley Building Smoke Test	Tested smoke detection and smoke movement under alternate egress requirements for a Breakthrough building.
Transportation and Handling Equipment — Operation Breakthrough	Documented transportation techniques and handling processes used for Operation Breakthrough housing systems.

The producer-evaluation project shows that Operation Breakthrough depended upon system analysis, laboratory testing, technical evaluation, and certification. NBS and outside laboratories were used to determine whether participating systems met the program's technical requirements.

The Coordinated Evaluation System

The Coordinated Evaluation System was established after the Executive Office of the President asked NBS in 1971 to develop programs that would reduce barriers created by the building-regulatory process. NCSBCS recommended the project.

CES Objective	Documented Work
State coordination	Assist states in developing coordinated and uniform evaluation, approval, and inspection systems.
Model documents	Develop rules, regulations, forms, and information flows for manufactured buildings and mobile homes.
Reduced duplication	Minimize repeated approvals and delays encountered by producers operating across jurisdictions.
Regulatory acceptance	Support use by state agencies, private evaluation and inspection agencies, and the manufactured-building industry.
Interstate reciprocity	Create consistent procedures that could support acceptance of approvals across state lines.

Project LEAP and CES

NBSIR 75-642 records the Laboratory Evaluation and Accreditation Program as an NBS program established in response to NCSBCS to develop a technical basis for evaluating laboratories and agencies serving manufactured-building regulation. The LEAP work was led by James O. Bryson; Robert D. Dikkers led the companion Coordinated Evaluation System (CES). The 1975 project summary describes five research documents but identifies only four by number, and records the creation of ASTM Committee E32 to process the material, with LEAP participation also occurring in ASTM Committee E36. Maryland and Massachusetts were used for pilot work.

NBS Special Publication 552 adds the fuller chronology: NCSBCS requested the program in 1970; NBS initiated LEAP in January 1971; four LEAP research reports were transferred by NBS and NCSBCS to ASTM; and E32 produced ASTM E541 by consensus in 1975. SP 552 also states that the Massachusetts pilot work “laid the groundwork for the Department of Commerce's Naval Facilities Engineering Command (NAVLAP) Program,” described there as a voluntary program intended to serve the needs of industry, consumers, government and others by accrediting the Nation's testing laboratories. That phrasing is quoted directly from SP 552 (p. 7); it is worth flagging that it reads as an internal inconsistency in the original NBS text, since NAVLAP is documented

elsewhere as the National Voluntary Laboratory Accreditation Program rather than a Naval Facilities Engineering Command program — but the wording above is exactly as SP 552 printed it, not an error introduced here.

3. NBS Special Publication 473 (1977): The NIBS Blueprint

SP 473 records the First NBS/NCSBCS Joint Conference, held in Providence, Rhode Island, September 21–22, 1976, and issued by NBS in June 1977. Its keynote address was delivered by Otis M. Mader, Chairman of the Board of Directors of the newly created National Institute of Building Sciences, under the title “The National Institute of Building Sciences—A Progress Report.”

Mader described Congress as responding to the lack of an authoritative national source for building science and technology, and presented NIBS as the institution intended to provide national coordination for evaluation, standards, innovation, and regulatory acceptance. He emphasized that “authoritative” was not regulatory power, but an institutional position earned through competence and participation.

What NIBS Said It Intended to Build

Mader presented eight strategies for NIBS. Among those documented in the record were:

- Establish NIBS as an authoritative national source of information on building science and technology, performance criteria and standards, and the building process.
- Develop a system for the formulation, promulgation, and maintenance of nationally recognized building performance criteria and standards and related technical provisions.
- Create a national system for the evaluation and prequalification of existing and new building technologies.
- Create a national building-regulation information program and mechanisms for coordinating the code process.
- Develop methods for introducing NIBS-promulgated innovations, criteria, and standards to local, state, and federal regulatory officials and facilitating their acceptance.
- Pursue initiatives that would allow NIBS eventually to become financially self-sustaining.

What Was Still Unfinished in 1976

The keynote also makes clear that the institution was still in startup mode. NIBS had only recently been chartered, was still searching for its full-time president and paid staff, had not completed its detailed mission statement, and had not yet organized the Consultative Council. Mader said NIBS was operating on a temporary \$140,000 HUD grant while submitting a five-year budget in support of \$10 million authorized by Congress as seed money and another \$10 million in resources NIBS believed it could develop.

“Create a national system for the evaluation and prequalification of existing and new building technologies.”

— Otis M. Mader, NBS SP 473

The Missing Middle in SP 473

By September 1976, ASTM E541 had already reached consensus from the earlier NBS/NCSBCS LEAP work. Yet Mader's NIBS blueprint does not identify Project LEAP or ASTM E541. SP 473 therefore documents a proposed national evaluation and prequalification system without naming the agency-qualification pathway that had already been developed — an omission that SP 552 later fills in. That

gap is central to understanding any later claim that housing-system certification work had simply been left undone: the record shows a real precursor already existed, even though the 1976 keynote did not name it.

4. NBS Special Publication 552 (1979): The LEAP-to-ASTM E541 Record

SP 552 records the Third Annual NBS/NCSBCS Joint Conference, held in Annapolis, Maryland, September 12, 1978, and issued by NBS in July 1979. Gene A. Rowland, Director of the NBS Office of Engineering Standards, provided the retrospective account that closes the historical loop.

The LEAP Chronology

Rowland frames LEAP against a specific backdrop: a trend toward greater industrialization through State-level certification of manufactured buildings and toward interstate reciprocity in the certification of buildings and components. Assurance to the building official of the caliber of the laboratories and agencies performing the evaluating and compliance-assurance functions for manufactured buildings was, in his words, “subject to some question,” and a way of assessing those organizations on a uniform, interstate basis was needed if one State's evaluations were to be confidently accepted by another.

NCSBCS asked NBS in 1970 to develop a program to accredit laboratories. NBS initiated the Laboratory Evaluation and Accreditation Program in January 1971 to develop the criteria by which laboratories could be evaluated against ANSI Standard A119.1, “Standard for Mobile Homes.” LEAP produced four research reports, which NCSBCS and NBS turned over to ASTM for processing as national consensus standards.

Two ASTM committees were established to process the documents: E32, “Criteria for Evaluating Agencies Concerned with Systems Analysis, Testing, and/or Compliance Assurance of Manufactured Buildings,” and E36, “Criteria for the Evaluation of Testing and/or Inspection Agencies.” The E32 Committee produced the standard that reached consensus in 1975 as ASTM E541, “Criteria for Evaluating Agencies Engaged in Systems Analysis and Compliance Assurance for Manufactured Buildings.” The E36 Committee, meanwhile, pressed ahead with the development of generic criteria for the evaluation of testing laboratories — a parallel track SP 552 records as still underway, separate from the E541 outcome.

“The E32 Committee produced a standard which in time (1975) was to win consensus agreement—ASTM E541.”

— Gene A. Rowland, NBS SP 552

Why SP 552 Matters

SP 552 is the federal publication that expressly connects the 1970 NCSBCS request, the January 1971 launch of LEAP, the four LEAP research reports, the transfer of that work to ASTM, and the 1975 consensus result. It therefore supplies the documentary link that the earlier 1975 project summary could only show in progress and that the 1976 NBS keynote did not name. SP 552 also states that the Massachusetts pilot work laid groundwork for the later voluntary laboratory-accreditation program described there.

5. From Project LEAP to ASTM E541

ASTM E541 was the consensus-standard result of the LEAP pathway. LEAP developed the criteria; NBS and NCSBCS carried the work into ASTM; ASTM Committee E32 processed the criteria for national use, reaching consensus in 1975 as ASTM E541, “Criteria for Evaluating Agencies Engaged in Systems Analysis and Compliance Assurance for Manufactured Buildings” (documented in NBS Special Publication 552, 1979).

6. A Single Building-Regulatory Framework

Layer	Program	Function
Housing system	Operation Breakthrough	Evaluate industrialized housing systems, producers, designs, testing, and performance.
Evaluation agency	Project LEAP	Determine whether laboratories and agencies are competent to perform analysis, testing, inspection, and compliance assurance.
State process	Coordinated Evaluation System	Provide uniform state documents and procedures for evaluation, approval, inspection, and interstate acceptance.
National standards	ASTM Committees E32 and E36 → ASTM E541 (1975)	Convert federal and state research into voluntary national consensus standards.

7. The Three Publications as One Timeline

Date	Federal record	What the combined record shows
1969–1973	Operation Breakthrough era	HUD and NBS evaluate industrialized housing systems, producers, testing, performance, and certification methods.
1970	Later documented in SP 552	NCSBCS asks NBS to develop a laboratory accreditation program.
January 1971	Later documented in SP 552	NBS initiates Project LEAP.
1971–1975	NBSIR 75-642 / later SP 552	LEAP and CES develop the agency-qualification and state-regulatory infrastructure around industrialized and manufactured construction.
1973–1975	NBSIR 75-642 / SP 552	LEAP research is moved into ASTM E32 and E36.
1975	SP 552 retrospective	ASTM E541 reaches consensus.
September 1976	SP 473	Mader presents NIBS as a future national hub for standards, evaluation, prequalification, information, and regulatory acceptance; LEAP/E541 are not named.
1978–1979	SP 552	Rowland records the earlier LEAP pathway and identifies ASTM E541 as its consensus-standard outcome.

8. Findings

Finding	Record
Operation Breakthrough was embedded in the Center for Building Technology.	Multiple HUD-sponsored Breakthrough projects appear within the Center's Standards and Codes program. (NBSIR 75-642)
System certification depended on technical evaluation infrastructure.	The producer-evaluation project used NBS and outside laboratories, engineering review, and full-scale testing. (NBSIR 75-642)
LEAP was connected to the same regulatory functions.	LEAP addressed the laboratories and agencies performing manufactured-building evaluation, testing, inspection, and compliance assurance. (NBSIR 75-642)
LEAP had a distinct formal origin.	Initiated in response to NCSBCS and sponsored by NBS, rather than identified as a HUD Operation Breakthrough subproject. (NBSIR 75-642; SP 552)

Finding	Record
The work moved into national consensus standards.	LEAP documents were transferred into ASTM Committee E32 and E36 processes, reaching consensus in 1975 as ASTM E541. (SP 552)
NIBS entered after the LEAP-to-ASTM pathway was already substantially built.	Congress created NIBS in 1974; ASTM E541 reached consensus in 1975; Mader presented the NIBS blueprint in September 1976. (SP 473; SP 552)
SP 473 and SP 552 create an important documentary contrast.	SP 473 describes a future national evaluation and prequalification system without naming LEAP/E541. SP 552 later documents that LEAP had already produced the agency-qualification pathway that became ASTM E541. (SP 473; SP 552)
The stated public purpose included wider consumer choice.	Rowland expressly connected uniform regulatory requirements and competent evaluation with larger markets, industrial innovation, and a wider consumer choice range. (SP 552)

Conclusion

NBSIR 75-642, NBS Special Publication 473, and NBS Special Publication 552 should be read together. The first shows the federal building-regulatory work in progress. The second shows the national role NIBS proposed to assume after its creation — without naming work that, by then, already existed. The third explains what became of Project LEAP and identifies ASTM E541 as the 1975 consensus-standard result of that work.

Taken together, the record does not support a history in which Operation Breakthrough simply ended and the supporting certification infrastructure vanished. Operation Breakthrough included Project LEAP and the standards-development work that produced ASTM E541 within the broader federal building-regulatory infrastructure. The system-level, agency-qualification, state-regulatory, and consensus-standards functions developed along different institutional paths, but they were connected parts of the same effort to make industrialized and manufactured construction easier to evaluate, approve, and accept across jurisdictions.

A broader housing-system certification framework and ASTM E541 are not the same instrument. But the three-source record shows that a substantial agency-evaluation and compliance-assurance layer was developed, transferred into ASTM, and preserved as a national consensus standard. Any present-day account of an “unfinished” housing-certification framework should account for that history rather than leap over it.

Closing: Consumer Choice Was the Public Purpose

“Enhancing the climate for new technology through the building regulatory system has been the intent of the Bureau’s service to NCSBCS. This service enables the States to describe more uniformly their regulatory requirements and to more accurately evaluate new construction materials and techniques, paving the way for the natural evolution of a market area sufficiently large and rewarding to stimulate industrial innovation. In turn, the consumer’s choice range is widened. It is the consumer who is the ultimate beneficiary of an improved regulatory climate.”

— Gene A. Rowland, Director, Office of Engineering Standards, National Engineering Laboratory, National Bureau of Standards

Primary Sources

- NBSIR 75-642: National Bureau of Standards, Project Summaries of the Center for Building Technology, National Bureau of Standards 1974–75 (January 1975). Relevant summaries include Standards and Codes, CES, LEAP, and the Operation Breakthrough projects.
- NBS Special Publication 473: National Bureau of Standards and National Conference of States on Building Codes and Standards, Research and Innovation in the Building Regulatory Process (June 1977), proceedings of the First Annual NBS/NCSBCS Joint Conference, including Otis M. Mader's keynote, 'The National Institute of Building Sciences—A Progress Report.'
- NBS Special Publication 552: National Bureau of Standards and National Conference of States on Building Codes and Standards, Research and Innovation in the Building Regulatory Process (July 1979), proceedings of the Third Annual NBS/NCSBCS Joint Conference, including Gene A. Rowland's keynote, 'A Perspective on NBS and NCSBCS Research and Assistance to the Building Regulatory Community,' which documents the LEAP-to-ASTM E541 pathway and the 1975 consensus result.

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