



ASME Standards Technology, LLC
Request for Proposals
RFP-ASMEST-07-05
B31(#2) - Impact Testing Exemption Curves

Date Posted: May 11, 2007

Proposal Due Date: June 15, 2007

1. Summary

ASME Standards Technology, LLC is soliciting proposals for technical investigation of the impact test exemption curves of ASME Section VIII, USC-66.

This project has resulted from ASME Pressure Technology Codes & Standards (PTCS) Standards Committee requests to identify, prioritize, and address technology gaps in current or new PTCS Codes, Standards and Guidelines. This project is one of several included for ASME FY08 funding and intended to establish and maintain the technical relevance of ASME codes & standards products. An overview of the annual ASME PTCS project selection process is included at <http://files.asme.org/STLLC/10192.pdf>.

2. Scope of Work

a. Scope Description

Investigate the impact test exemption curves of ASME Section VIII, USC-66. The goals of the investigation include:

- To extend the curves (particularly Curves A and B) to lower temperatures and thicknesses less than 0.394 inches
- To investigate the technical and historical origin of these curves
- To expand in a more systematic and complete way the several exceptions to these curves, namely USC-66(d) and UG-20(f)
- To evaluate all of this data in light of modern steel production methods, which produce materials that are less prone to low temperature failures

ASME Section VIII, USC-66 requires impact testing of certain materials according to curves shown in Figure USC-66. These curves relate material thickness and temperature to a type of material. Impact testing is required as a function of design temperature for material specifications and thicknesses. According to the curves, thinner materials have lower allowable design temperatures without impact testing and the curves get quite steep as the thickness gets less.

ASME B31.5, Pressure Piping Code for Refrigeration Piping, includes provisions to derate the allowable stress of carbon steel materials when used at low temperatures. Recently B31.5 has adopted some of the provisions of UCS-66 for determining when impact testing is required. However, USC-66 Curves A and B are truncated below 18°F and -20°F, respectively, and below 0.394 inches thickness. It is in this region (i.e., < -20°F and < 0.394" thick) that most of the industrial refrigeration piping falls.

The end result of this project will be new and extended curves or an entirely new format applied to impact testing criteria. The extension of these curves down to lower temperatures and thicknesses will be a great benefit to the industrial refrigeration industry.

Additional background information is included in the Attachment to this RFP.

b. Deliverable

The project deliverable shall be a technical report provided as an electronic file in MS Word format. The report outline shall be approved by ASME ST-LLC. One peer review cycle is anticipated and modifications required to the report, as a result of the review cycle, are the responsibility of the contractor awarded the contract.

c. Schedule

Investigators shall submit a schedule with their proposal describing the major milestones and reporting schedule. ASME ST-LLC desires that the final deliverable be provided no later than June 30, 2008.

d. Reporting:

Progress reports shall be provided at ASME B31 code week meetings.

e. Travel Requirements

Current travel is anticipated to present project results to ASME C&S committees during ASME B31 code week meetings. Travel expenses shall be reimbursed, within the project budget, per the project Travel Policy.

f. Budget

The total budget is approximately \$20,000.

3. Applicant Eligibility Requirements

ASME ST-LLC is seeking proposals from all qualified organizations including, but not limited to, engineering firms, consultants, academic institutions and Federally Funded Research and Development Centers. In addition to relevant technical qualifications and experience, applicants must possess an understanding of relevant ASME Codes and Standards.

4. Basis for Selection and Award

Selection of a proposal by ASME ST-LLC will be achieved through a process of evaluating and comparing the relative merits of the applicant's complete responses. This process reflects ASME ST-LLC's desire to accept an application based on its potential in best achieving program objectives, rather than solely on evaluated technical merit or cost. Evaluation criteria includes, but is not limited to, the following:

- Technical capabilities
- Experience
- Price
- Schedule
- Agreement with Terms and Conditions

ASME ST-LLC reserves the right to award, in whole or in part, any, all, or none of the applications submitted in response to this solicitation.

5. Contract Terms and Conditions

A fixed-price contract is preferred, however labor hour and expenses-type proposals will also be considered. Draft terms and conditions are attached. The final contractual terms and conditions will be negotiated between ASME ST-LLC and the selected applicant(s) following award.

ASME ST-LLC shall provide required access to codes and standards and other technical references necessary for performance of the work.

6. Submission Requirements

- a. Proposal Due Date: Proposals and amendments of proposals must be received by June 15, 2007. Applicants are encouraged to transmit their proposal well before the deadline.
- b. Anticipated Selection and Award Date: It is anticipated that selection and award will be made within 2 weeks of the proposal due date.
- c. Application Preparation Costs: This solicitation does not obligate ASME ST-LLC to pay any costs incurred in the preparation and submission of proposals or in making necessary studies or designs for the preparation thereof or to acquire, or contract for any services.
- d. Application Clarification: ASME ST-LLC reserves the right to require proposals to be clarified or supplemented to the extent considered necessary. The award may be made after few or no exchanges, discussions or negotiations. Therefore, all applicants are advised to submit their most favorable application to ASME ST-LLC. ASME ST-LLC reserves the right, without qualification, to reject any or all proposals received in response to this solicitation and to select any proposal, in whole or in part, as a basis for negotiation and or award. ASME ST-LLC reserves the right to modify or cancel this solicitation. All questions relating to the solicitation must be submitted to the contact below. Any amendments to the solicitation will be posted on the ASME ST-LLC web site (http://stllc.asme.org/Requests_Proposals_RFPs.cfm).
- e. Treatment of Proprietary Information: A proposal may include technical data and other data, including trade secrets and/or privileged or confidential commercial or financial information, which the applicant does not want disclosed to the public or used by ASME ST-LLC for any purpose other than proposal evaluation. To protect such data, the applicant should specifically identify the data to be protected.
- f. Proposal Preparation and Submittal Instructions:
ASME ST-LLC may form a committee of subject matter experts to evaluate the technical qualifications of applicants. To help facilitate this evaluation, responses should include two separate documents, a Technical Proposal, and a Financial Proposal.
 1. Technical Proposal
 - (a) Provide organization name and contact information.
 - (b) Provide evidence of technical capabilities: the credentials, qualifications, capabilities, and experience of individuals and the organization.
 - (c) Describe approach to accomplishment of the Scope of Work.

- (d) Confirm agreement with the Scope of Work for the specified task(s)
- 2. Financial Proposal
 - (a) Provide a fixed price quotation or an hourly billing rate quotation and estimated project maximum.
 - (b) Confirm agreement with the draft Terms and Conditions, or state any specific exceptions.
- 3. Submit Technical and Financial Proposals via e-mail to the ASME ST-LLC contact below.
- 4. Responses must be received on or before the deadline.

7. ASME Standards Technology, LLC Contact Information:

Name: John Koehr
President
ASME Standards Technology, LLC
Three Park Avenue
New York, NY 10016 USA
Telephone: 212-591-8511
Fax: 212-591-7196
E-mail: koehrj@asme.org
Web: www.stllc.asme.org

B31 Request #2

**Impact Testing Exemption Curves more
Meaningful for Piping**

SUBMITTED 5/5/04 TO CSTI

RAM
5/5/04

SCOPE

We are proposing an investigation of the Impact Test Exemption Curves of Section VIII, UCS-66. The goal of this investigation would be:

- 1.) to extend the curves (particularly Curves A and B) to lower temperatures and thicknesses less than 0.394 inches.
- 2.) to investigate the technical and historical origin of these curves.
- 3.) to expand (in a more systematic and complete way) the several exceptions to these curves, namely USC-66(d) and UG-20(f). To the outsider, these exceptions are mysterious singularities in the requirements of Figure UCS-66.
- 4.) to evaluate all of this data in light of modern steel production methods, which we are told, produce materials that are much less prone to low temperature failures.

BUSINESS NEED

The BPV Code Section VIII, UCS-66 requires impact testing of certain materials according to curves shown in Figure UCS-66. These curves relate material thickness and temperature to a type of material. Thus, knowing a material spec and thickness, we can see if impact testing is required as a function of design temperature. According to the curves, thinner materials have lower allowed design temperatures without impact testing and the curves get quite steep as the thickness gets less.

ASME B31.5 the Pressure Piping Code for Refrigeration Piping has had a longstanding provision that severely derates the allowable stress of carbon steel materials when used at low temperatures. It uses a derate of 0.4, or safety factor increase of 2.5x. Recently, to soften the penalty of this derate, B31.5 has adopted some of the provisions of UCS-66 for determining when impact testing is required.

However, studying UCS-66, Curves A and B are truncated at 18F and -20F respectively and at 0.394 inches thickness. It is exactly in this region (below -20 and less than 0.394 thick) that most of the industrial refrigeration piping fails. Just when it looks like UCS-66 is going to help the refrigeration piping business, it gets truncated in what appears to be an arbitrary manner.

Just looking at a straight line extrapolation of Curves A and B between 0.394 and 0.099 shows some benefit in lower minimum design temperatures. Looking at the curves, a straight line extrapolation would be conservative. Note that UG-84 does not provide for impact testing of materials below 0.099 thickness.

Also, in UCS-66, there is a blanket requirement for impact testing any time the design metal temperature is below -55F. (Without derating the allowable material stresses; which means, significantly oversizing the piping safety factors, see Fig. UCS-66.1)

There are exceptions to these rules, however, in UCS-66(d) and UG-20(f).

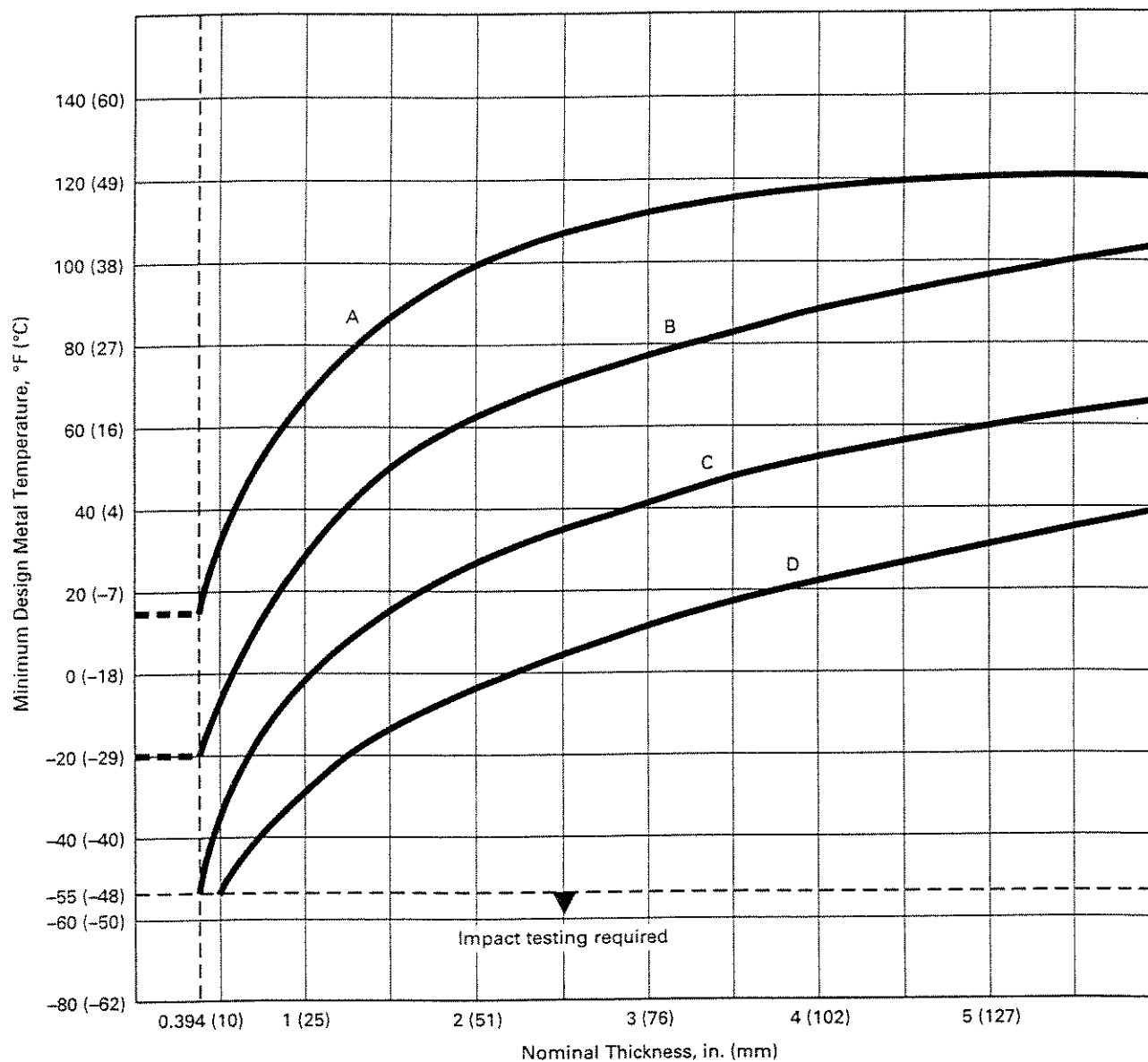
In UCS-66(d) ,second sentence {which was added in 1994} pipe sizes NPS 4 and smaller of P-No. 1 materials, as a function of Yield Strength and thickness, are allowed to go down to -155F without impact testing. If you attempt to plot these exceptions on Figure UCS-66 they are clearly far beyond the limitations of Curves A, B, C and D AND far beyond the limitations of the first sentence of paragraph UCS-66(d).

In UG-20(f) for some materials, another exception drops Curve A to -20F at ½ inch thickness and less and Curve B drops to -20F at 1 inch thickness and less. Again, clearly a large step beyond the limits of Curve A and B.

These exceptions must have some technical or historical backup to support them. It is apparent that impact strength is a function of material thickness and Yield Strength and P-No.s. These exceptions are far outside the limits of the original Curves, existing either as singularity points {as in UCS-66(d)} or as step functions {as in UG-20(f)}. If 4 inch pipe is good down to -155F, would 6 inch pipe be good down to, say, -100F. Or would 8 inch pipe be good down to -75F or -55F? If Curve B materials 1 inch thick can be user down to -20F, could Curve B materials ¾ inch thick be used down to -55F ? These are the kinds of answers that would be a real service to the "customers" of B31.5. The first three goals of this project are directed towards these questions.

At the same time we are asking ourselves these questions about the underlying science that established the UCS-66 curves and exceptions, we are being told by steel pipe suppliers that steel today is different. It is no longer manufactured by the ingot methods used only a few years ago. The continuous casting methods are "cleaner", have better control of carbon content and are much more resistant to brittle fracture. The fourth goal of this project is to verify (and quantify) these claims.

The end result of this project would be new and extended curves, or an entirely new format applied to impact testing criteria. The extension of these curves down to lower temperatures and thicknesses would be a great benefit to the industrial refrigeration industry. For example, a simple blanket extension of Curve B materials down to -55F would relieve piping contractors and engineers of the burden of extra calculations, oversized pipe schedules, purchasing and tracking multiple grades of pipe and fittings on the same job site as well as extra testing and inspections. If the science and manufacturing methods supports this, we owe it to our "customers" to update our Codes.



[Limited to 4 in. (102 mm) for Welded Construction]

General Notes and Notes follow on next two pages

FIG. UCS-66 IMPACT TEST EXEMPTION CURVES [SEE NOTES (1) AND (2)] [SEE UCS-66(a)]

FIG. UCS-66 (CONT'D)

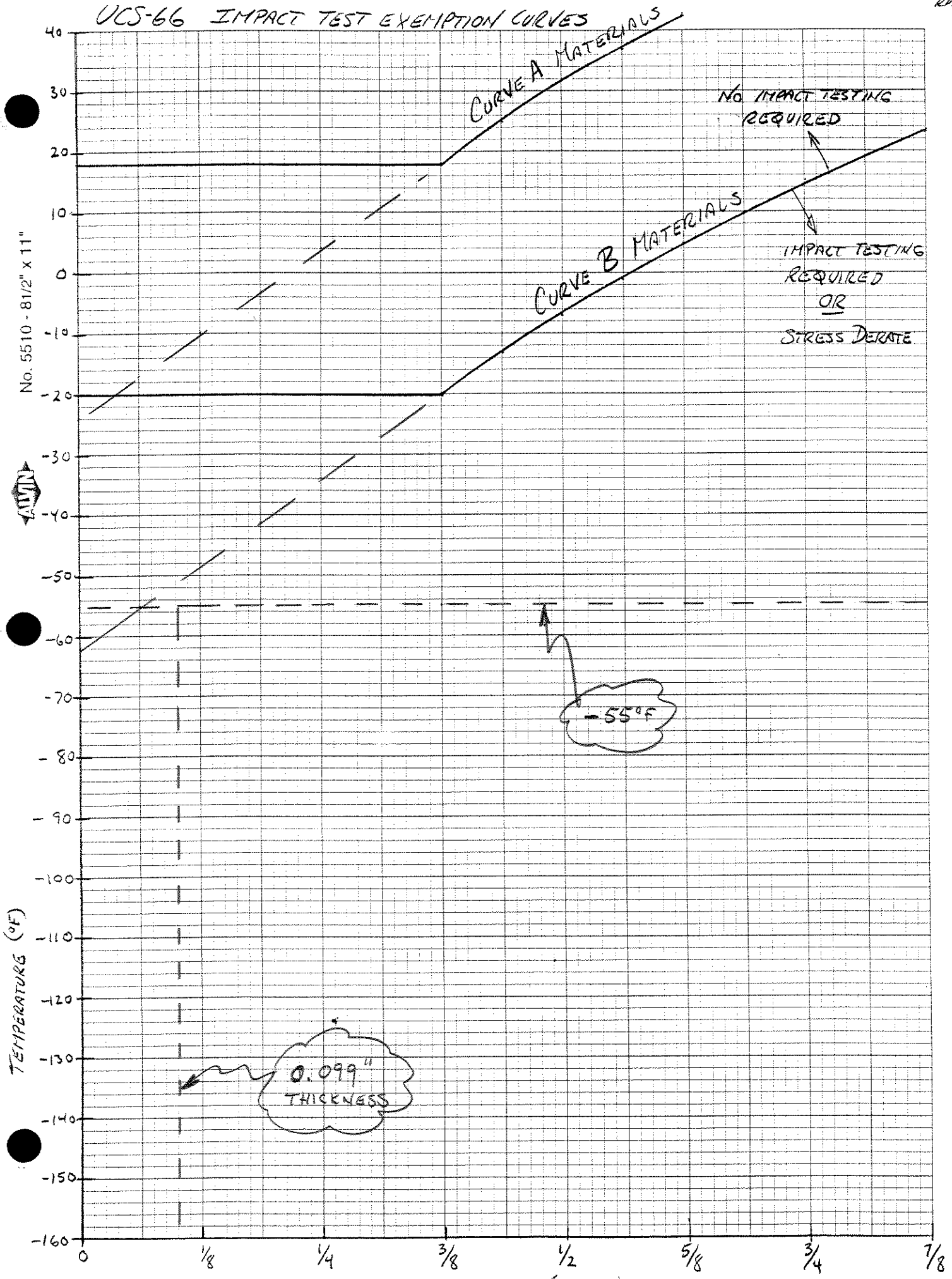
GENERAL NOTES ON ASSIGNMENT OF MATERIALS TO CURVES:

- (a) Curve A applies to:
 - (1) all carbon and all low alloy steel plates, structural shapes, and bars not listed in Curves B, C, and D below;
 - (2) SA-216 Grades WCB and WCC if normalized and tempered or water-quenched and tempered; SA-217 Grade WC6 if normalized and tempered or water-quenched and tempered.
- (b) Curve B applies to:
 - (1) SA-216 Grade WCA if normalized and tempered or water-quenched and tempered
SA-216 Grades WCB and WCC for thicknesses not exceeding 2 in. (51 mm), if produced to fine grain practice and water-quenched and tempered
SA-217 Grade WC9 if normalized and tempered
SA-285 Grades A and B
SA-414 Grade A
SA-515 Grade 60
SA-516 Grades 65 and 70 if not normalized
SA-612 if not normalized
SA-62 Grade B if not normalized;
 - (2) except for cast steels, all materials of Curve A if produced to fine grain practice and normalized which are not listed in Curves C and D below;
 - (3) all pipe, fittings, forgings and tubing not listed for Curves C and D below;
 - (4) parts permitted under UG-11 shall be included in Curve B even when fabricated from plate that otherwise would be assigned to a different curve.
- (c) Curve C
 - (1) SA-182 Grades 21 and 22 if normalized and tempered
SA-302 Grades C and D
SA-336 F21 and F22 if normalized and tempered
SA-387 Grades 21 and 22 if normalized and tempered
SA-516 Grades 55 and 60 if not normalized
SA-533 Grades B and C
SA-662 Grade A;
 - (2) all material of Curve B if produced to fine grain practice and normalized and not listed for Curve D below.
- (d) Curve D
 - SA-203
 - SA-508 Grade 1
 - SA-516 if normalized
 - SA-524 Classes 1 and 2
 - SA-537 Classes 1, 2, and 3
 - SA-612 if normalized
 - SA-662 if normalized
 - SA-738 Grade A
 - SA-738 Grade A with Cb and V deliberately added in accordance with the provisions of the material specification, not colder than -20°F (-29°C)
 - SA-738 Grade B not colder than -20°F (-29°C)
- (e) For bolting and nuts, the following impact test exemption temperature shall apply:

Bolting		
Spec. No.	Grade	Impact Test Exemption Temperature, °F (°C)
SA-193	B5	-20 (-29)
SA-193	B7 [2½ in. (64 mm) dia. and under]	-55 (-48)
	[Over 2½ in. to 7 in. (64 mm to 178 mm), incl.]	-40 (-40)
SA-193	B7M	-55 (-48)
SA-193	B16	-20 (-29)
SA-307	B	-20 (-29)
SA-320	L7, L7A, L7M, L43	Impact tested
SA-325	1, 2	-20 (-29)
SA-354	BC	0 (-18)
SA-354	BD	+20 (-7)
SA-449	...	-20 (-29)
SA-540	B23/24	+10 (-12)

General Notes and Notes continue on next page

UCS-66 IMPACT TEST EXEMPTION CURVES



No. 5510 - 8 1/2" x 11"

ALVIN

TEMPERATURE (°F)

CURVE A MATERIALS

CURVE B MATERIALS

NO IMPACT TESTING
REQUIRED

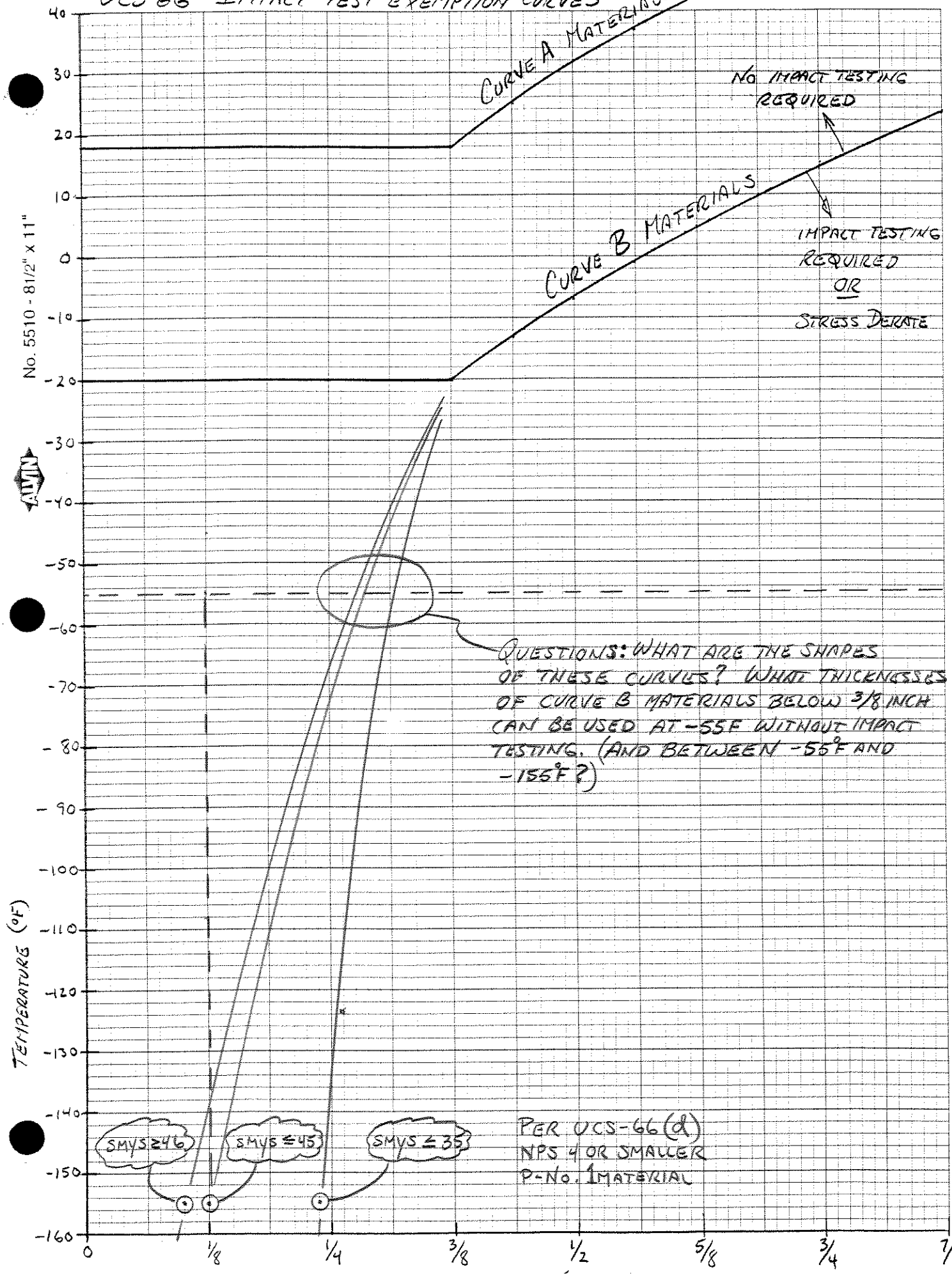
IMPACT TESTING
REQUIRED
OR
STRESS DERATE

-55°F

0.099"
THICKNESS

2002 SECTION VIII
 UCS-66 IMPACT TEST EXEMPTION CURVES

4/14/64
 RPM



UG-20 DESIGN TEMPERATURE

(a) *Maximum.* Except as required in UW-2(d)(3), the maximum temperature used in design shall be not less than the mean metal temperature (through the thickness) expected under operating conditions for the part considered (see 3-2). If necessary, the metal temperature shall be determined by computation or by measurement from equipment in service under equivalent operating conditions.

(b) *Minimum.* The minimum metal temperature used in design shall be the lowest expected in service except when lower temperatures are permitted by the rules of this Division (see UCS-66). The minimum mean metal temperature shall be determined by the principles described in (a) above. Consideration shall include the lowest operating temperature, operational upsets, autorefrigeration, atmospheric temperature, and any other sources of cooling [except as permitted in (f)(3) below].

(c) Design temperatures listed in excess of the maximum temperatures listed in the tables referenced in UG-23 are not permitted. In addition, design temperatures for vessels under external pressure shall not exceed the maximum temperatures given on the external pressure charts.

(d) The design of zones with different metal temperatures may be based on their determined temperatures.

(e) Suggested methods for obtaining the operating temperature of vessel walls in service are given in Appendix C.

(f) Impact testing per UG-84 is not mandatory for pressure vessel materials which satisfy all of the following.

(1) The material shall be limited to P-No. 1, Gr. No. 1 or 2, and the thickness, as defined in UCS-66(a), shall not exceed that given in (a) or (b) below:

(a) $\frac{1}{2}$ in. for materials listed in Curve A of Fig. UCS-66;

(b) 1 in. for materials listed in Curve B, C, or D of Fig. UCS-66.

(2) The completed vessel shall be hydrostatically tested per UG-99(b), (c), or (k).

(3) Design temperature is no warmer than 650°F nor colder than -20°F. Occasional operating temperatures colder than -20°F are acceptable when due to lower seasonal atmospheric temperature.

(4) The thermal or mechanical shock loadings are not a controlling design requirement. (See UG-22.)

(5) Cyclical loading is not a controlling design requirement. (See UG-22.)

UG-21 DESIGN PRESSURE⁸

Vessels covered by this Division of Section VIII shall be designed for at least the most severe condition of coincident pressure and temperature expected in normal operation. For this condition and for test conditions, the maximum difference in pressure between the inside and outside of a vessel, or between any two chambers of a combination unit, shall be considered [see UG-98, UG-99(e), and 3-2].

UG-22 LOADINGS

The loadings to be considered in designing a vessel shall include those from:

(a) internal or external design pressure (as defined in UG-21);

(b) weight of the vessel and normal contents under operating or test conditions (this includes additional pressure due to static head of liquids);

(c) superimposed static reactions from weight of attached equipment, such as motors, machinery, other vessels, piping, linings, and insulation;

(d) the attachment of:

(1) internals (see Appendix D);

(2) vessel supports, such as lugs, rings, skirts, saddles, and legs (see Appendix G);

(e) cyclic and dynamic reactions due to pressure or thermal variations, or from equipment mounted on a vessel, and mechanical loadings;

(f) wind, snow, and seismic reactions, where required;

(g) impact reactions such as those due to fluid shock;

(h) temperature gradients and differential thermal expansion.

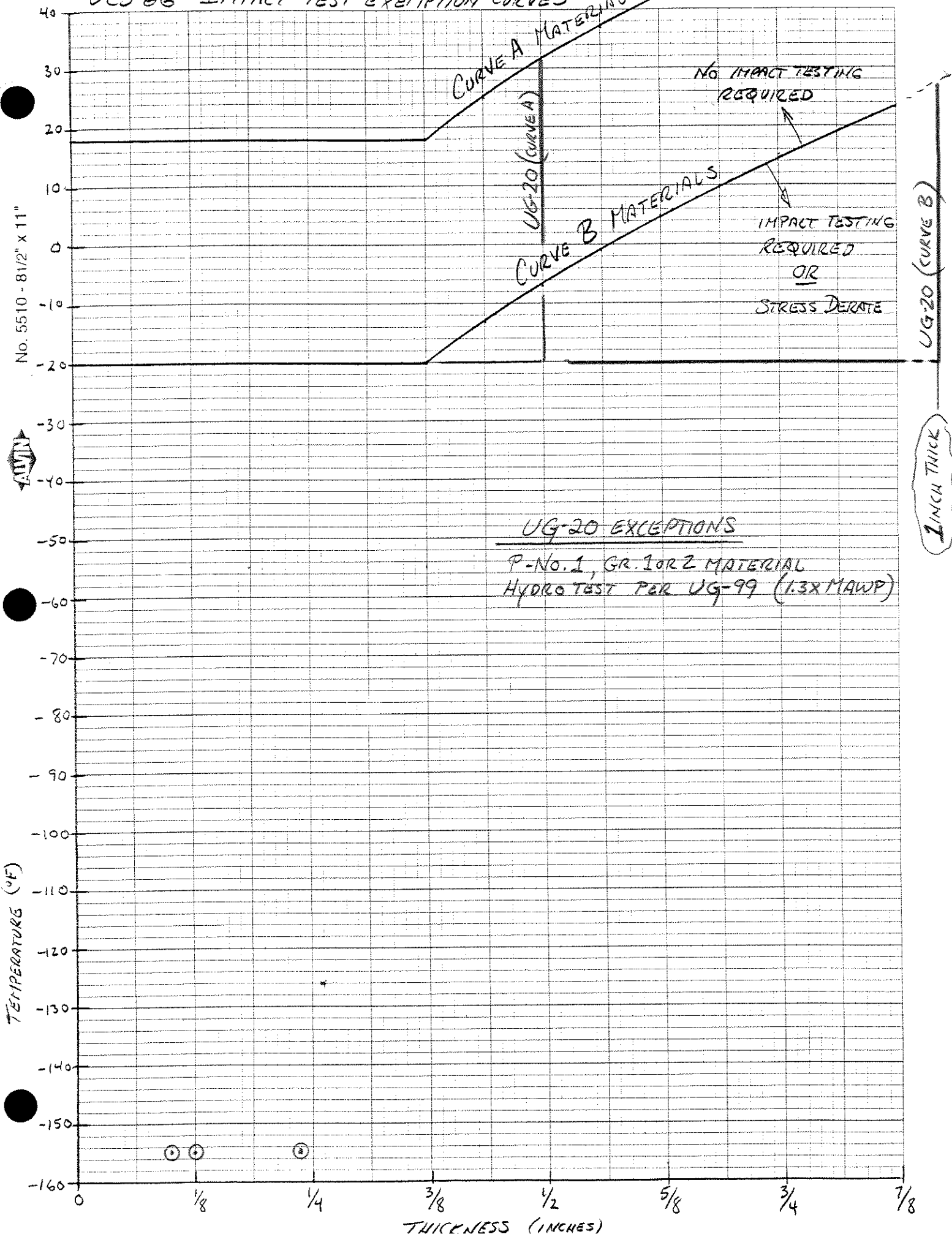
UG-23 MAXIMUM ALLOWABLE STRESS VALUES⁹

(a) The maximum allowable stress value is the maximum unit stress permitted in a given material used in a vessel constructed under these rules. The maximum allowable tensile stress values permitted for different materials are given in Subpart 1 of Section II, Part D. A listing of these materials are given in the following tables, which are included in Subsection C. For ma-

⁸ It is recommended that a suitable margin be provided above the pressure at which the vessel will be normally operated to allow for probable pressure surges in the vessel up to the setting of the pressure relieving devices (see UG-134).

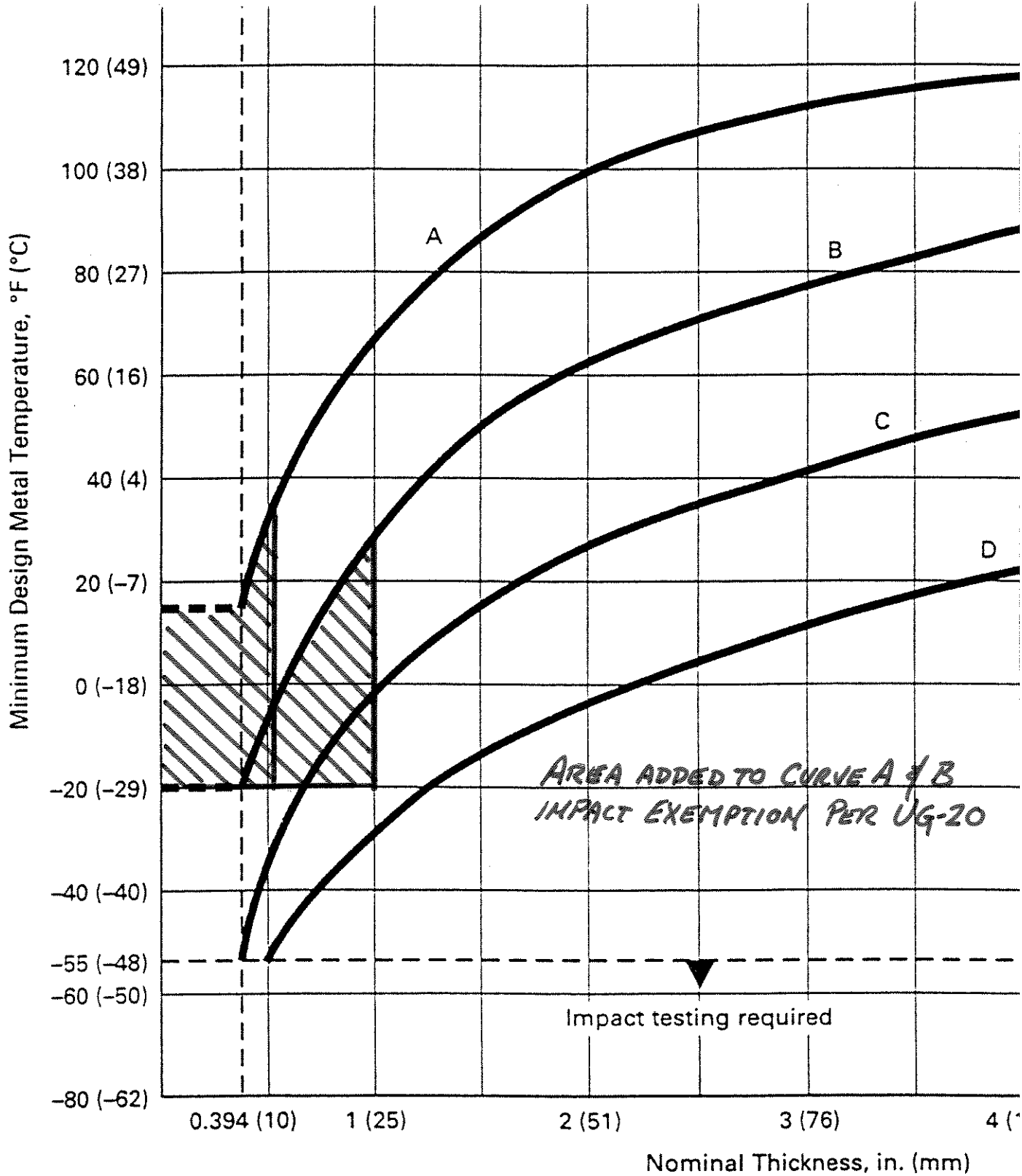
⁹ For the basis on which the tabulated stress values have been established, see Appendix 1 of Section II, Part D.

UCS-66 IMPACT TEST EXEMPTION CURVES



UG-20 EXCEPTIONS
 P-No. 1, GR. 1 OR 2 MATERIAL
 HYDRO TEST PER UG-99 (1.3X MAWP)

1 INCH THICK



[Limited to 4 in. (102 mm) for Welded Constr

General Not

FIG. UCS-66 IMPACT TEST EXEMPTION CURVES [SEE NOTES (1) /