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AMENDMENT 1
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Petroleum and natural gas industries — Fixed steel offshore structures

AMENDMENT 1

Industries du pétrole et du gaz naturel — Structures en mer fixes en acier

AMENDEMENT 1

Reference number
ISO 19902:2007/Amd.1:2013(E)

Foreword

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The committee responsible for this document is ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*, Subcommittee SC 7, *Offshore structures*.

Petroleum and natural gas industries — Fixed steel offshore structures

AMENDMENT 1

Page 14, Clause 5

Delete:

PLS progressive collapse limit state

Replace with:

PLS progressive collapse limit states

Page 15, 6.1.1

Delete:

NOTE There have been historical differences in the usage and understanding of the terms “jacket” and “tower”, particularly between the USA and Europe. The difference in such understanding of the terms has no significant impact on the application of this International Standard as long as the differences in structural behaviour are considered in the analyses of the different structures.

Replace with:

NOTE 1 There have been historical differences in the usage and understanding of the terms “jacket” and “tower”, particularly between the USA and Europe. The difference in such understanding of the terms has no significant impact on the application of this International Standard as long as the differences in structural behaviour are considered in the analyses of the different structures.

NOTE 2 There have been historical differences, which continue to exist, in the use and understanding of the term “caisson”. In the offshore oil and gas industry this term, together with its variants “braced caisson” or “free-standing caisson” (see, respectively, 3.7 and 3.22), has traditionally been used to refer to a particular type of minimum fixed structure, where the main component is a relatively large diameter tubular member, with or without additional lateral support, intended to satisfy various functional requirements such as supporting one or more wells, or supporting small decks and associated facilities. Conversely, in the geotechnical arena the term “caisson” has traditionally been used to refer to “foundation caisson”, i.e. foundation component /system consisting of shorter and more rigid chamber of larger diameter or larger lateral dimensions than the caisson structures described above.

Clause 17 covers the geotechnical design of long slender piles (i.e. satisfying the condition $L/D \geq 10$, where L is the length embedded in the soil, and D is the outside diameter) for fixed steel structures. The provisions of that clause apply also to braced or free-standing caisson structures with $L/D \geq 10$. However, the content of Clause 17 does not apply to the design of short and rigid, large diameter foundations with $L/D < 10$. Guidance on the geotechnical design of this type of foundations is within the scope of ISO 19901-4.

Page 20, 6.6.2

Renumber the existing list as: a) b) c).

Page 23, 7.1

Delete:

The general principles on which structural design requirements are based are documented in ISO 19900. ISO 19900 requires that structural design be performed with reference to a specified set of limit states. For each limit, state design situations shall be determined and an appropriate calculation model shall be established

Replace with:

The general principles on which structural design requirements are based are documented in ISO 19900. ISO 19900 requires that structural design be performed with reference to a specified set of limit states. For each limit state, design situations shall be determined and an appropriate calculation model shall be established

Page 23, 7.2

Renumber the existing list as: a) b) c) d).

Page 27, Clause 8

Add the following below "Actions for pre-service and removal situations":

IMPORTANT — Users of this document should be aware of the publication of ISO 19901-6, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 6: Marine operations*, which followed publication of the first edition of ISO 19902. Where the provisions in ISO 19901-6 now overlap with ISO 19902, ISO 19901-6 may be used in preference.

Page 31, 8.3.2

Renumber the existing list as: a) b) c).

Page 31, 8.3.5

Renumber the existing list as: a) b).

Page 81, 12.4.4.6

Delete:

b) where foundation failure occurs before structural failure, structural failure should be determined by assuming a foundation capacity based on upper bound estimates of soil properties. The upper bound approach, b) above, provides an assessment of the steel structure strength.

Replace with:

b) where foundation failure occurs before structural failure, structural failure should be determined by assuming a foundation capacity based on upper bound estimates of soil properties.

The upper bound approach, b) above, provides an assessment of the steel structure strength.

Page 83, 12.5.6

Delete:

— Quasi-static analysis, in which static non-linear analysis procedures are used, with the environmental actions enhanced by a set of equivalent quasi-static inertial actions representing the dynamic response. The set of equivalent quasi-static inertial actions may be determined in a manner analogous to the procedures in 9.8 and A.9.8. A static pushover analysis can then be performed using the procedure suggested in 12.5.4.

Replace with:

— Quasi-static analysis, in which static non-linear analysis procedures are carried out using the environmental actions enhanced by a set of equivalent quasi-static inertial actions representing the dynamic response. The set of equivalent quasi-static inertial actions may be determined in a manner analogous to the procedures in 9.8 and A.9.8. A static pushover analysis can then be performed using the procedure suggested in 12.5.4.

Page 86, 13.1

After the first paragraph, add:

— For structural shapes, other than circular tubulars, the requirements and recommendations given in ISO 19901-3 are applicable. ISO 19901-3 provides for specific guidance on detailing and dimensioning to be taken from an onshore building standard and describes a methodology in which a correspondence factor is introduced to address any differences in the derivation of the action and resistance factors of different standards.

Page 92, 13.2.6.2, Equation (13.2-28)

Delete:

$$C_\mathrm{h} = 0{,}44t/D + 0{,}21(D/t)^3 \mu^4$$

Replace with:

$$C_\mathrm{h} = 0{,}44t/D + 0{,}21(D/t)^3 / \mu^4$$

Page 102, Figure 13.6-1

Delete the figure title:

Typical unstiffened and stiffened conical transition

Replace with:

Typical unstiffened and stiffened conical transitions

Page 128, Figure 14.2-2 h)

Reverse the direction of the arrow corresponding to “500” on the axis of brace “3”, at right of the drawing, so that the arrowhead points to the right.

Page 132, Figure 14.2-4

Delete:

$d_2 \geq 600$

Replace with:

$\geq d_2$,

≥ 600

Delete:

$d_2 /4 \geq 150$

Replace with:

$\geq d_2/4$,

≥ 150

Page 139, 14.5

Renumber the existing list as: a) b) c) d).

Page 143, 15.1.4

Renumber the existing list as: a) b) c).

Equation (15.1-2)

Delete:

$$\sigma_t = \frac{M_t}{\pi D_p^2 L_e}$$

Replace with:

$$\sigma_t = \frac{2M_t}{\pi D_p^2 L_e}$$

Page 154, 15.3.6.2

Renumber the existing list as: a) b) c) d) e).

Page 171, 16.8.1

Delete the second paragraph:

A deterministic fatigue analysis method is not recommended for final checking of structures in harsh fatigue environments. It can find application for screening evaluations during the initial design stages, or for a final fatigue assessment of structures for which dynamic effects can be neglected and that are not critically fatigue sensitive. It is included in this International Standard only in order to cover such general applications. Guidance on dynamically responding structures is given in 16.4.3 and 16.6.4.

Replace with:

A deterministic fatigue analysis method is not recommended for final checking of structures in harsh fatigue environments. It can find application for screening evaluations during the initial design stages, or for a final fatigue assessment of structures for which dynamic effects can be neglected and that are not critically fatigue sensitive. It is included in this International Standard only in order to cover such general applications. Guidance on dynamically responding structures is given in 16.4.4 and 16.6.3.

Page 182, 17.1.1

Delete the first paragraph:

This clause establishes requirements for foundation design. Pile foundations and, more specifically, steel cylindrical (pipe) pile foundations are addressed in 17.1 to 17.11. Considerations for the design of shallow foundations are given in 17.12, while design requirements and guidance can be found in ISO 19901-4. A.17 contains discussion and guidance on the requirements of Clause 17.

Replace with:

This clause establishes requirements for foundation design. Pile foundations and, more specifically, foundations consisting of steel cylindrical (pipe) piles or structural caissons (see 6.1.1) with slenderness ratio $L/D \geq 10$, where L is the embedded length and D is the outside diameter, are addressed in 17.1 to 17.11. Guidance for pile foundations with $L/D < 10$ can be found in ISO 19901-4. Considerations for the design of shallow foundations are given in 17.12, while design requirements and guidance can be found in ISO 19901-4. A.17 contains discussion and guidance on the requirements of Clause 17.

Page 194, 17.8.2, Equation (17.8-1)

Delete:

$$p_r = 3 \cdot c_u \cdot D = p_0{}' D + J c_u X$$

Replace with:

$$p_r = 3 \cdot c_u \cdot D + p_0{}' D + J c_u X$$

Page 212, Figure 19.1-1

Delete:

Specific material selection to be shown on design drawing and specifications

Replace with:

Specific material selection to be shown on design drawings and specifications

Page 216, 19.6.1

Delete the first and second paragraphs:

High sulphate-resisting Portland cement or API standard oilwell cement grouts, mixed with fresh water should be used. Sea water shall not be used in cement and grout mixes due to chemical attacks, potential corrosion and other potential adverse durability effects.

Water should be freshly drawn and be free of hydrocarbons and other deleterious matter.

Replace with:

In general, Portland cement grouts should be used with or without inert fillers mixed with either seawater or fresh water. However, there may be special circumstances where the use of seawater is undesirable because of corrosion or other durability effects.

Any water used to mix grout should be free of hydrocarbons and other deleterious matter.

Page 219, 20.2.1

Delete:

s) production weld joint details and tolerances, including

  9) welding of single-sided T-, Y- and K-joints,

  10) other welds;

t) post-weld heat treatment;

u) heat straightening limits;

v) weld size/profile limits;

w) environmental limitations for welding;

x) back-gouging/backing/runoff tab criteria;

y) preparation of base metal (cleaning, bevelling, etc.);

z) fatigue improvement techniques (if applicable);

aa) NDT procedures;

bb) NDT discontinuity acceptance criteria;

cc) repairs.

Replace with:

h) production weld joint details and tolerances, including

  1) welding of single-sided T-, Y- and K-joints,

  2) other welds;

i) post-weld heat treatment;

j) heat straightening limits;

k) weld size/profile limits;

l) environmental limitations for welding;

m) back-gouging/backing/runoff tab criteria;

n) preparation of base metal (cleaning, bevelling, etc.);

o) fatigue improvement techniques (if applicable);

p) NDT procedures;

q) NDT discontinuity acceptance criteria;

r) repairs.

Page 221, 20.2.2.4.2

Renumber the existing list as: a) b) c) d).

Page 234, 21.8

Renumber the existing list as: a) b) c) d) e) f) g).

Page 242, 22.5.8

Renumber the existing list as: a) b) c).

Page 243, 22.5.9

Delete the second paragraph:

Any change in the hammers to be used for pile driving shall be assessed, in order to ensure that the consequences of the change are acceptable (including pile drivability, pile capacity, pile and structure strength and fatigue).

Replace with:

Any change in the hammers to be used for pile driving shall be assessed, in order to ensure that the consequences of the change are acceptable (including pile driveability, pile capacity, pile and structure strength and fatigue).

Page 252, 23.4.3

Delete:

1) Special

Special inspections are conducted to monitor repairs, remediation programmes, known damage and defects, or known areas of vulnerability (underdesign, scour, etc.). Special inspections can also be needed for structure reuse (see Clause 25). The key features of special inspections are definition of the objectives, selection of appropriate tools and techniques, scopes of work, and inspection intervals.

Replace with:

3) Special

Special inspections are conducted to monitor repairs, remediation programmes, known damage and defects, or known areas of vulnerability (underdesign, scour, etc.). Special inspections can also be needed for structure reuse (see Clause 25). The key features of special inspections are definition of the objectives, selection of appropriate tools and techniques, scopes of work, and inspection intervals.

Page 252, 23.4.4

Delete:

a) scheduling flexibility, including

— intervals between periodic inspections, and

— promptness of post-event and post-incident inspections;

nn) cost, capability and availability of inspection equipment and services, including

— inspection tools and specialized equipment,

— personnel,

— deployment and support vessels and equipment,

— seasonal weather windows;

oo) regional differences, such as those resulting from environmental differences, including

— the severity and frequency of storms,

— conditions relevant for fatigue,

— seismicity levels,

— wind speeds, and/or

— the presence of sea ice and icebergs;

pp) reliability and applicability of inspection technique(s), e.g. probability of detection and accuracy of sizing, which should be considered with due regard to the type of data required and the sensitivity of the structure to a particular form of damage.

Replace with:

a) scheduling flexibility, including

— intervals between periodic inspections, and

— promptness of post-event and post-incident inspections;

b) cost, capability and availability of inspection equipment and services, including

— inspection tools and specialized equipment,

— personnel,

— deployment and support vessels and equipment,

— seasonal weather windows;

c) regional differences, such as those resulting from environmental differences, including

— the severity and frequency of storms,

— conditions relevant for fatigue,

— seismicity levels,

— wind speeds, and/or

— the presence of sea ice and icebergs;

d) reliability and applicability of inspection technique(s), e.g. probability of detection and accuracy of sizing, which should be considered with due regard to the type of data required and the sensitivity of the structure to a particular form of damage.

Page 262, 24.2

Delete:

g) perform a resistance assessment, see 24.9, using

1) design level analysis,

2) ultimate strength level analysis, and

3) prevention and mitigation, see 24.10.

Replace with:

g) perform a resistance assessment, see 24.9, using

1) design level analysis,

2) ultimate strength level analysis, and

h) prevention and mitigation, see 24.10.

Page 302, A.9.5.2.4

Delete:

The blockage factor for steady current can be estimated from the "actuator disk" model [A.9.5-23] as

Replace with:

The blockage factor for steady current can be estimated from the "actuator disk" model [A.9.5-22] as

Page 315, A.9.11, Equation (A.9.11-1)

Delete:

$$F_{\mathrm{L,\,max}} = C_{\mathrm{L,\,max}} \cdot 1/2 \rho_{\mathrm{w}} D U^{2}{}_{\mathrm{max}}$$

Replace with:

$$F_{\mathrm{L,\,max}} = C_{\mathrm{L,\,max}} \cdot \frac{1}{2} \rho_{\mathrm{w}} D U^{2}{}_{\mathrm{max}}$$

Equation (A.9.11-2)

Delete:

$$F_{\mathrm{s}} = C_{\mathrm{s}} \cdot 1/2 \rho_{\mathrm{w}} D U^{2}$$

Replace with:

$$F_{\mathrm{s}} = C_{\mathrm{s}} \cdot \frac{1}{2} \rho_{\mathrm{w}} D U^{2}$$

Page 359, A.13.7.2.4

Delete the first paragraph:

When dented tubulars are subjected to bending moments resulting in tensile (positive) or zero (neutral) stresses in the centre region of the dent, the bending strength of the dented tubular is not appreciably lower than that of an undamaged member. The representative bending strength Equations for members under positive [Equation (13.7-16) or neutral (Equation (13.7-20)] bending are thus similar to that for undamaged members [Equation (13.2-11)].

Replace with:

When dented tubulars are subjected to bending moments resulting in tensile (positive) or zero (neutral) stresses in the centre region of the dent, the bending strength of the dented tubular is not appreciably lower than that of an undamaged member. The representative bending strength Equations for members under positive [Equation (13.7-16)] or neutral [Equation (13.7-20)] bending are thus similar to that for undamaged members [Equation (13.2-11)].

Page 401, A.15.3.4.3.2

Delete:

The interface transfer stress σ_{p} acting on the clamp is according to Equation (A.15.3-6):

$$\sigma_{\mathrm{p}} = \frac{S}{\pi D L_{\mathrm{s}}} \qquad \text{(A.15.3-6)}$$

where

S is the slip force;

L_{s} is the length of the clamp over which the slip force is assumed to transfer.

Replace with:

The interface transfer stress σ_p acting on the clamp is according to Equation (A.15.3-6):

$$\sigma_p = \frac{P_{Sl}}{\pi D L_s} \qquad (A.15.3\text{-}6)$$

where L_s is the length of the clamp over which the slip force, P_{Sl}, is assumed to transfer.

Page 403, key to Figure A.15.3-3

Delete:

M prying moment [Equation (A.15.3-8)]

Replace with:

M prying moment [Equation (A.15.3-7)]

Page 404, A.15.3.4.3.3, Equation (A.15.3-11)

Delete:

$$\sigma_p = \frac{1}{2} \cdot \frac{S}{\pi D L_s} f_p = \frac{1}{2} \cdot \frac{S}{\pi D L_s} \qquad (A.15.3\text{-}11)$$

Replace with:

$$\sigma_p = 2 \cdot \frac{S}{\pi D L_s} f_p = 2 \cdot \frac{S}{\pi D L_s} \qquad (A.15.3\text{-}11)$$

Page 409, A.15.3.4.3.5, Equation (A.15.3-21)

Delete:

$$\sigma_p \le \frac{f_g}{\gamma_{R,g}} \qquad (A.15.3\text{-}20)$$

Replace with:

$$\sigma_p \le \frac{f_p}{\gamma_{R,g}} \qquad (A.15.3\text{-}20)$$

Page 416, A.16.3.7

Delete:

The probability that the individual wave height, H, in a sea state with significant wave height, H_S, has a particular value, H^*, is given by $p(H^*)\mathrm{d}H$, where $p(H^*)$ is the Rayleigh probability density function:

$$P(H^*) = \frac{4H^*}{H_s^2} \cdot \exp\left[\frac{-2(H^*)^2}{H_s^2}\right] \qquad (A.16.3\text{-}1)$$

The cumulative probability, $p(H > H^*)$, that the individual wave height, H, exceeds the value H^* in the sea state with significant wave height H_S is thus

$$P(H > H^*) = \int_{H^*}^{\infty} p(H)\mathrm{d}H = \int_{H^*}^{\infty} \frac{4H}{H_s^2} \cdot \exp\left[\frac{-2H^2}{H_s^2}\right] \cdot \mathrm{d}H = \exp\left[\frac{-2(H^*)^2}{H_s^2}\right] \qquad (A.16.3\text{-}2)$$

Replace with:

The probability that the individual wave height, H, in a sea state with significant wave height, H_S, has a particular value, H^*, is given by $p(H^*)\mathrm{d}H$, where $p(H^*)$ is the Rayleigh probability density function:

$$p(H^*) = \frac{4H^*}{H_s^2} \cdot \exp\left[\frac{-2(H^*)^2}{H_s^2}\right] \qquad \text{(A.16.3-1)}$$

The cumulative probability, $P(H > H^*)$, that the individual wave height, H, exceeds value H^* in the sea state with significant wave height H_S is thus

$$P(H > H^*) = \int_{H^*}^{\infty} p(H)\mathrm{d}H = \int_{H^*}^{\infty} \frac{4H}{H_s^2} \cdot \exp\left[\frac{-2H^2}{H_s^2}\right] \cdot \mathrm{d}H = \exp\left[\frac{-2(H^*)^2}{H_s^2}\right] \qquad \text{(A.16.3-2)}$$

Page 440, Figure A.16.10-2

Delete:

$\alpha = L/2D$

Replace with:

$\alpha = 2L/D$

Page 454, Table A.16.10-7

In column 1, delete:

1.1 Plain steel

a) In the as-rolled condition or ground smooth

or machined after cutting.

d) With edges flame cut.

No repair by weld refill

Replace with:

1.1 Plain steel

a) In the as-rolled condition or ground smooth

or machined after cutting.

b) With edges flame cut.

No repair by weld refill

Page 463, A.16.11.4

Delete the second paragraph:

The TJ and OJ representative curves are based on a material thickness of 16 mm. EWI derived a thickness exponent of 0,29, compared with 0,3 in the HSE investigations. Given the similarity of these values, an exponent of 0,3 is specified.

Replace with:

The TJ and OJ representative curves are based on a material thickness of 16 mm. EWI derived a thickness exponent of 0,29, compared with 0,3 in the HSE investigations. API use a value of 0,25 while in Norsok the range is from 0,15 to 0,25 and work by DNV has indicated that 0,25 is generally applicable unless there are high SCFs; consequently a value of 0,25 has been selected for Equation (16.11-2).

Page 465, A.16.12.2

Delete the third paragraph:

Both the factor of 5 and the factor of 10 imply that a significant change in fatigue reliability only occurs when there is a significant change in the predicted life (or Palmgren-Miner damage sum) for the design service life of the structure. As the slopes of the S–N curves vary between 3 and 5, values $1 < \gamma_{FD} < 10$ are equivalent to much smaller changes in the calculated stresses of from 1,38 S to 1,71 S for a factor of 5 and from 1,58 S to 2,15 S for a factor of 10.

Replace with:

Both the factor of 5 and the factor of 10 imply that a significant change in fatigue reliability only occurs when there is a significant change in the predicted life (or Palmgren-Miner damage sum) for the design service life of the structure. As the slopes of the S–N curves vary between 3 and 5, values $1 < \gamma_{FD} \leq 10$ are equivalent to much smaller changes in the calculated stresses from 1,38 S to 1,71 S for a factor of 5 and from 1,58 S to 2,15 S for a factor of 10.

Page 478, A.17.4.4.2.1

Delete:

p_a is the atmospheric pressure, in stress units, Pa = 100 kPa;

Replace with:

p_a is the atmospheric pressure, in stress units, p_a = 100 kPa;

Page 506, A.20.3

Delete the first paragraph:

In some cases, it is not necessary to undertake 100 % inspection with all methods. The requirements given in Annexes E and F allow for inspection of a proportion of the length of the welds of certain types and for certain categories or classes of structure. The reduced extent of inspection is dependent on the welds being of good quality; consequently, if the defect identification is too high, the extent of inspection should be increased as below.

Replace with:

In some cases, it is not necessary to undertake 100 % inspection with all methods. The requirements given in Annexes E and F allow for inspection of a proportion of the length of the welds of certain types and for certain categories or classes of structure. The reduced extent of inspection is dependent on the welds being of good quality; consequently, if the defect identification is too high, the extent of inspection should be increased as described below.

Page 593, H.3.3

Modify the subclauses of H.3.3, renumbering them accordingly, as follows:

Delete H.3.3.1 and H.3.3.2.

Replace H.3.3.2 (becomes H.3.3.1) with:

H.3.3.1 Partial action factors

The partial action factor for environmental actions shall be 1,35 for L1 structures (see 9.10), unless rational analysis demonstrates that an alternative value is appropriate.

Delete H.3.3.3 to H.3.3.13 inclusive.

Replace H.3.3.13 (becomes H.3.3.2) with the following:

H.3.3.2 Welding

If the welding standard selected for use is CSA W59, “Welded Steel Construction (Metal Arc Welding)”, the additional requirements provided in Annex U of that standard shall be used.

CSA W59 with Annex U (offshore welding requirements) is anticipated for publication in 2013 or 2014. Until the publication of CSA W59 with the offshore welding requirements (Annex U), if CSA W59-03 is selected for use, the provisions of the additional requirements given in Annexes A, B, and C of CSA-S473-04:2004 [H.11], shall be used.

When CSA W59, “Welded Steel Construction (Metal Arc Welding)”, is not the welding standard selected for use, the owner shall ensure that the following subject areas, are addressed by the selected welding standards or by project specifications:

a) Welding fabrication company:

   1) Qualified welding engineering personnel;

   2) Qualified welding supervisory personnel;

   3) Documented, qualified and approved welders and welding operators with regular validation of qualifications;

   4) Documented, qualified, and approved welding procedures.

b) Welding inspection company:

   1) Documented, qualified, and approved welding inspection/nde procedures for methods used and products inspected, including special practices for tubular TKY connections, when applicable;

   2) Qualified welding inspection/nde supervisory personnel;

   3) Documented qualified welding inspection/nde personnel with regular validation of qualification, including special qualifications for TKY connections when applicable.

c) Welding inspectors qualified on the basis of training, experience and examination in the method used and products inspected, including tubular TKY connections, when applicable.

The above qualifications for items (a), (b), and (c) shall be recognized as being equivalent to those referenced in CSA W59, Annex U.

The owner shall utilize the services of a recognized independent third party organization to verify ongoing compliance with these requirements.

Delete H.3.4.1 to H.3.4.5 inclusive.

Page 605, Bibliographical reference A.13.9-9

Delete:

[A.13.9-9] British Standards Institution (BSI), *Steel, Concrete, and Composite Bridges — Part 5. Code of Practice for Design of Composite Bridges*, BS 5400-5, London, 1979

Replace with:

[A.13.9-9] British Standards Institution (BSI), *Steel, Concrete, and Composite Bridges — Part 5. Code of Practice for Design of Composite Bridges*, BS 5400-5, London, 1979 (Withdrawn and superseded by EN 1994-2)

Page 610, Bibliographical reference A.16.15-1

Delete:

[A.16.15-1] British Standards Institution, BS PD 6493 *Guidance on Methods for Assessing the Acceptability of Flaws in Fusion Welded Structures*, London, 1991

Replace with:

[A.16.15-1] British Standards Institution, BS 7910:2005 *Guides to methods of assessing the acceptability of flaws in metallic structures*, London, 2005.

ICS 75.180.10

Price based on 14 pages