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National Standards of the People's Republic of China

GB 713 - XXXX
Superseding GB 713-1997 and GB 6654-1996

Steel plates for boilers and pressure vessels

(ISO 9328-2: 2004, Steel flat products for pressure purposes - Technical delivery conditions - Part 2: Non-alloy and alloy steels with specified elevated temperature properties, NEQ)

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of the People's Republic of China**

Foreword

Except the agreement provisions all other technical contents in this standard are mandatory.

This standard has been produced by non-equivalently adopting ISO 9328-2: 2004 Steel flat products for pressure purposes – Technical delivery conditions - Part 2: Non-alloy and alloy steels with specified elevated temperature properties and in reference with EN10028-2: 2003 Specification for flat products made of steel for pressure purposes, combining and revising GB 713-1997 Steel plates for boilers and GB 6654-1996 Steel plates for pressure vessels.

GB 713-1997 Steel plates for boilers and GB 6654-1996 Steel plates for pressure vessels will be superseded by this standard as from its issue date.

In comparison with GB 713-1997 and GB 6654-1996 the main changes are as follows:

- Extending the range of steel plate thicknesses and widths;
- Changing the designation of standard names and codes;
- Abolishing 15MnVR and 15MnVNR, and bringing in 14Cr1MoR and 12Cr2Mo1R;
- Combining 20R and 20g as Q245R, combining 16MnR, 16Mng and 19Mng as Q345R and combining 13MnNiMoNbR and 13MnNiCrMoNbg as 13MnNiMoR;
- Reducing the S and P composition in all codes;
- Raising the V type impact work criterion;
- Abolishing the 20g and 16Mng aging impact test.

This standard was proposed by the China Iron and Steel Industry Association.

This standard is under the jurisdiction of the National Steel Standardisation Technical Committee.

The main drafting organisations of this standard included Chongqin Iron and Steel Co. Ltd, the Standard Research Institute of Metallurgy Industry Information, Angang Steel Co. Ltd, General Mechanical Engineering Company of China, Wuhan Steel (Group) Co. Ltd, Jinan Steel Co. Ltd and the China Special Equipment Institute and Research College.

The main drafters of this standard were Li Hong, Wang Xiaohu, Qin Xiaozhong, Tang Yifan, Du Dasong, Piao Zhimin, Li Shurui and Zhang Aimin.

The standard supersedes the following previously issued versions:

- GB 713-1963, GB 713-1972, GB 713-1986 and GB 713-1997;
- GB 6654-1996.

Steel plates for boilers and pressure vessels

1 Scope

This standard specifies the dimensions, shape, technical requirements, test methods, inspection rules, packaging, marking and quality certification, etc. of steel plates for boilers and pressure vessels.

The standard applies to steel plates with a thickness ranging from 3 mm to 200 mm for boilers and their accessories and pressurised components in pressure vessels at normal temperature.

2 Normative References

The provisions of the following documents become provisions of this standard after being referenced. For dated reference documents, all later amendments (excluding corrigenda) and versions do not apply to this standard; however, any parties that come to an agreement under this standard are encouraged to consider adopting the latest versions of these documents. For undated reference documents, the latest versions apply to this standard.

- GB/T 222 Permissible tolerances for the chemical composition of steel products
- GB/T 223.3 Methods for chemical analysis of iron, steel and alloy – The diantipyryl methane phosphomolybdate gravimetric method for the determination of phosphorus content
- GB/T 223.10 Methods for chemical analysis of iron, steel and alloy – The cupferron separation-chrome azurol S photometric method for the determination of aluminium content
- GB/T 223.11 Methods for chemical analysis of iron, steel and alloy – The ammonium persulphate oxidation volumetric method for the determination of chromium content
- GB/T 223.14 Methods for chemical analysis of iron, steel and alloy – The N-benzoyl-N-phenylhydroxylamine extraction photometric method for the determination of vanadium content
- GB/T 223.17 Methods for chemical analysis of iron, steel and alloy – The diantipyrylmethane photometric method for the determination of titanium content
- GB/T 223.18 Methods for chemical analysis of iron, steel and alloy – The sodium thiosulphate separation iodimetric method for the determination of copper content
- GB/T 223.23 Methods for chemical analysis of iron, steel and alloy – The dimethylglyoxime spectrophotometric method for the determination of nickel content
- GB/T 223.26 Methods for chemical analysis of iron, steel and alloy – The thiocyanate direct photometric method for the determination of molybdenum content
- GB/T 223.27 Methods for chemical analysis of iron, steel and alloy – The thiocyanate-butyl acetate extraction spectrophotometric method for the determination of molybdenum content
- GB/T 223.40 Iron, steel and alloy – Determination of niobium content by the sulphochlorophenol S spectrophotometric method
- GB/T 223.60 Methods for chemical analysis of iron, steel and alloy – The perchloric acid dehydration gravimetric method for the determination of silicon content
- GB/T 223.63 Methods for chemical analysis of iron, steel and alloy – The sodium (potassium) periodate photometric method for the determination of manganese content
- GB/T 223.68 Methods for chemical analysis of iron, steel and alloy – The potassium iodate titration method after combustion in the pipe furnace for the determination of sulphur content
- GB/T 223.69 Methods for chemical analysis of iron, steel and alloy – The gas-volumetric method after combustion in the pipe furnace for the determination of carbon content
- GB/T 223.76 Methods for chemical analysis of iron, steel and alloy – The flame atomic absorption spectrometric method for the determination of vanadium content (GB/T 223.76-1994, eqv ISO 9647:1989)
- GB/T 228 Metallic materials – Tensile testing at ambient temperature (GB/T 228-2002, eqv ISO 6892: 1998)
- GB/T 229 Metallic materials – Charpy notch impact test
- GB/T 232 Metallic materials – Bend test (GB/T 232-1999, eqv ISO 7438: 1985)
- GB/T 247 General rules of acceptance, packaging, marking and certification for steel plates (sheets) and strips
- GB/T 709 Dimensions, shape, weight and tolerances for hot-rolled steel plates and sheets
- GB/T 2970 Thicker steel plates – Method for ultrasonic inspection
- GB/T 2975 Steel and steel products – Location and preparation of test pieces for mechanical testing (GB/T 2975-1998, eqv ISO 377: 1997)
- GB/T 4336 Standard test method for spark discharge atomic emission spectrometric analysis of carbon and low-alloy steel (routine method)
- GB/T 4338 Metallic materials – Tensile testing at elevated temperatures (GB/T 4338-2007, ISO)
- GB/T 5313 Steel plate with through-thickness characteristics (GB/T 5313-1985, eqv ISO 7778: 1983)
- GB/T 6803 Standard method for conducting drop-weight tests to determine the inductility transition temperature of ferrite steels

GB/T 17505 Steel and steel products – general technical delivery requirements (GB/T 17505-1998, eqv ISO 404: 1992)

GB/T 20066 Steel and iron – Sampling and preparation of samples for the determination of chemical composition
YB/T 081 Rule for rounding off of numerical values and judgement of testing values for technical standards in metallurgy

JB/T 4730.3 Non-damaging test for equipment under pressure

3 Order Content

Order contracts or order forms produced in line with this standard must include the following contents:

- a) Standard serial number;
- b) Name of the product;
- c) Code;
- d) Dimensions;
- e) Delivery condition;
- f) Weight;
- g) Special technical requirements (such as ultrasonic testing, improving impact properties).

4 Formation of Code

Carbon steel and low alloy and high strength steel are coded with their yielding strength and the initials Q for yielding and R for vessel in the Chinese spelling, for example Q245R.

Molybdenum steel and chromium-molybdenum steel are coded with the average carbon content and the initials of the alloy element and R for vessel in the Chinese spelling, for example 15CrMoR.

5 Dimensions, shape, weight and tolerance

- 5.1 The dimensions, shape, weight and tolerance of the steel plates should meet the requirements of GB/T 709.
- 5.2 The thickness tolerance should conform to the B category tolerance of GB/T 709. According to the buyer's requirements and the agreement between the buyer and the seller, steel plates with a reduced lower tolerance on the same tolerance can be supplied.
- 5.3 The steel plates are delivered in their theoretical weight. The thickness used for the theoretical weight calculation is the average thickness of the maximum allowed thickness and the minimum allowed thickness of the steel plates. The density of steel plates is taken as 7.85 g/cm³.

6 Technical requirements

6.1 Code and chemical composition

- 6.1.1 The code and chemical composition (melting analysis) of the steel plates should conform to the requirements in Table 1.
 - 6.1.1.1 The carbon upper limit can be raised to 0.22% for Q345R steel plates with a thickness greater than 60 mm.
 - 6.1.1.2 The residue of chrome, nickel and copper is less than 0.30% each, the residue of molybdenum is less than 0.080% and the total content of these elements is less than 0.70% with the seller's guarantee without the need for further analysis.
 - 6.1.1.3 Small traces of niobium, vanadium and titanium are permissible in Q245R, Q345R and Q370R steel, the content of them should be listed in the quality certificate and the total amount of the above mentioned 3 elements should not exceed 0.05%, 0.10% and 0.12% respectively.
 - 6.1.1.4 The P content can be $\leq 0.015\%$ and the S content can be $\leq 0.005\%$ for Q345R and Q370R steel, and the P content can be $\leq 0.012\%$ for 14Cr1MoR and 12Cr2Mo1R steel according to the buyer's requirements and the agreement between the buyer and the seller.
 - 6.1.1.5 According to the buyer's requirements and the agreement between the buyer and the seller the carbon equivalent can be specified for Q245R, Q345R and Q370R steel with a value agreed by both sides. The carbon equivalent is calculated by the formula (1):

$$CE (\%) = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 \dots\dots\dots (1)$$
 - 6.1.1.6 The Al_T content can be determined by measuring the acid dissolved aluminium and the Al_S content for the test should not be lower than 0.015%.
- 6.1.2 The permitted variations in the chemical content of the finished steel plates should conform to the requirements of GB/T 222.

6.2 Manufacturing methods

- 6.2.1 The steel is smelted using an oxygen converter or electric furnace.
- 6.2.2 The compression ratio of the continuous casting pre-form is no less than 3.

6.3 Delivery conditions

- 6.3.1 The delivery conditions of steel plates should conform to the requirements in Table 2.
- 6.3.2 The tempering temperature for 18MnMoNbR, 13MnNiMoR, 15CrMoR and 14Cr1MoR steel should be no lower than 620°C; the tempering temperature for 12Cr2Mo1R and 12Cr1MoVR steel should be no lower than 680°C.
- 6.3.3 Subject to agreement by both sides, 18MnMoNbR, 13MnNiMoR, 15CrMoR, 14Cr1MoR, 12Cr2Mo1R and 12Cr1MoVR steel plates with a thickness greater than 60 mm can be delivered either annealed or tempered. The test samples of these coded steel plates should be heat-treated under delivery conditions according to Table 2 and their performance should meet the requirements of Table 2. The size of the samples should be no less than 3a X a X 3a (a is the thickness of the plate).
- 6.3.4 Subject to agreement by both sides, chrome molybdenum steel plates can be delivered having undergone speeded-up tempering after normalisation.
- 6.3.5 The steel plates should be delivered with shear-cut or flame-cut edges. Where the available equipment imposes limitations, steel plates may be delivered with raw edges if this has been agreed by both sides and noted in the contract.

6.4 Mechanics and process performance

- 6.4.1 The results of the tensile test, Charpy (V-type notch) impact test and bending test should conform to the requirements of Table 2. Steel plates with a thickness greater than 60 mm can be exempted from the bending test requirement, if this has been agreed by both sides and noted in the contract.
 - 6.4.1.1 According to the buyer's requirements and the agreement between the buyer and seller, an impact test at -20°C can replace the impact test at 0°C in Table 2 and its impact value should meet the requirements of Table 2.
 - 6.4.1.2 The value of the Charpy (V-type notch) impact test is taken from the average of three samples and one value from the three samples may be lower than the value specified in Table 2 but no lower than 70% of said value.
 - 6.4.1.3 The auxiliary test sample should be used for steel plates with a thickness of less than 12 mm during the Charpy (V-type notch) impact test. The size of the auxiliary sample is 10 mm X 7.5 mm X 55 mm for steel plates with a thickness of >8 mm to <12 mm and the test result may not be 75% lower than the value specified in Table 2; the size of the auxiliary sample is 10 mm X 5 mm X 55 mm for steel plates with a thickness of 6 mm to 8 mm and the test result may not be 50% lower than the value specified in Table 2; the impact test requirement can be exempted for steel plates with a thickness of less than 6 mm.
- 6.4.2 According to the buyer's requirements and the agreement between the buyer and the seller the high temperature tensile test can be carried out for the steel plates thicker than 20 mm. The test temperature should be listed in the contract. The non-proportional proof strength ($R_{p0.2}$) or the lower yielding strength (R_{eL}) should conform to the requirements in Table 3.
- 6.4.3 According to the buyer's requirements and the agreement between the buyer and the seller the tensile test can be carried out in the direction of the thickness and the test result should be stated in the quality certificate.
- 6.4.4 According to the buyer's requirements and the agreement between the buyer and the seller the drop-weight test can be carried out and the test result should be stated in the quality certificate.

6.5 Ultrasonic test

According to the buyer's requirements and the agreement between the buyer and the seller an ultrasonic test can be carried out on each steel sheet. The test method should be in accordance with GB/T 2970 or JB/T 4730.3. The test standard and the qualification grade should be stated in the contract.

6.6 Surface quality

- 6.6.1 The surface of steel plates should have no cracks, bubbles, scars, puckers or impurities. The steel plates should not be layered. Steel plates with the abovementioned flaws may be rectified. The rectification depth should be no greater than half of the steel plate's thickness tolerance and the minimum thickness of the steel plate at the rectification area should be guaranteed. The steel plates should be smooth and have no sharp corners after the rectification of any flaw.
- 6.6.2 Other flaws are permitted, provided that they are no greater than half of the steel plate's thickness tolerance and the minimum thickness of the steel plate at the flaw area should be guaranteed.

6.7 Other additional requirements

According to the buyer's requirements and the agreement between the buyer and the seller other requirements can be added for chrome molybdenum steel plates in a hydrogen environment, anti-HIC carbon steel and low-alloy steel.

Table 1 – Chemical Composition

| Code | Composition (mass fraction) % | | | | | | | | | | |
|--------------------|-------------------------------|--------------|---------------------------|--------------|--------------|--------------|----------------|--------------|---------|---------|---------|
| | C ^b | Si | Mn | Cr | Ni | Mo | Nb | V | P | S | Alt |
| Q245R ^a | ≤ 0.20 | ≤ 0.35 | 0.50 to 1.00 ^c | | | | | | ≤ 0.025 | ≤ 0.015 | ≥ 0.020 |
| Q345R ^a | ≤ 0.20 | ≤ 0.55 | 1.20 to 1.60 | | | | | | ≤ 0.025 | ≤ 0.015 | ≥ 0.020 |
| Q370R | ≤ 0.18 | ≤ 0.55 | 1.20 to 1.60 | | | | 0.015 to 0.050 | | ≤ 0.025 | ≤ 0.015 | |
| 18MnMoNbR | ≤ 0.22 | 0.15 to 0.50 | 1.20 to 1.60 | | | 0.45 to 0.65 | 0.025 to 0.050 | | ≤ 0.020 | ≤ 0.010 | |
| 13MnNiMoR | ≤ 0.15 | 0.15 to 0.50 | 1.20 to 1.60 | 0.20 to 0.40 | 0.60 to 1.00 | 0.20 to 0.40 | 0.005 to 0.020 | | ≤ 0.020 | ≤ 0.010 | |
| 15CrMoR | 0.12 to 0.18 | 0.15 to 0.40 | 0.40 to 0.70 | 0.80 to 1.20 | | 0.45 to 0.60 | | | ≤ 0.025 | ≤ 0.010 | |
| 14Cr1MoR | 0.05 to 0.17 | 0.50 to 0.80 | 0.40 to 0.65 | 1.15 to 1.50 | | 0.45 to 0.65 | | | ≤ 0.020 | ≤ 0.010 | |
| 12Cr2Mo1R | 0.08 to 0.15 | ≤ 0.50 | 0.30 to 0.60 | 2.00 to 2.50 | | 0.90 to 1.10 | | | ≤ 0.020 | ≤ 0.010 | |
| 12Cr1MoVR | 0.08 to 0.15 | 0.15 to 0.40 | 0.40 to 0.70 | 0.90 to 1.20 | | 0.25 to 0.35 | | 0.15 to 0.30 | ≤ 0.025 | ≤ 0.010 | |

^a – Where Nb, Ti and V are added to the steel the lower limit of Alt is not applicable.

^b – According to the buyer's requirements and the agreement between the buyer and the seller the lower limit of the C content can be ignored.

^c – The higher limit of M content for steel plates with a thickness greater than 60 mm can be extended to 1.20%.

Table 2 – Mechanics and process performance

| Code | Delivery Condition | Thickness of Steel Plate (mm) | Tensile Test | | | Impact Test | | Bending Test |
|-----------|---|-------------------------------|--|---|----------------------|----------------|---------------------------------|--------------|
| | | | Tensile Strength R_m , N/mm ² | Yielding Strength ^a R_{eL} , N/mm ² | Elongation Rate A, % | Temperature °C | V-Type Impact Work A_{KV} , J | 180° d=2a |
| | | | | no less than | | | no less than | |
| Q245R | Heat Rolling, Controlled Rolling or Normalisation | 3-16 | 400-520 | 245 | 25 | 0 | 31 | d=1.5a |
| | | >16-36 | | 235 | | | | |
| | | >36-60 | | 225 | | | | |
| | | >60-100 | 390-510 | 205 | 24 | | | d=2a |
| | | >100-150 | 380-500 | 185 | | | | |
| Q345R | | 3-16 | 510-640 | 345 | 21 | 0 | 34 | d=2a |
| | | >16-36 | 500-630 | 325 | | | | |
| | | >36-60 | 490-620 | 315 | | | | |
| | | >60-100 | 490-620 | 305 | 20 | | | d=3a |
| | | >100-150 | 480-610 | 285 | | | | |
| >150-200 | 470-600 | 265 | | | | | | |
| Q370R | Normalisation | 10-16 | 530-630 | 370 | 20 | -20 | 34 | d=2a |
| | | >16-36 | | 360 | | | | |
| | | >36-60 | 520-620 | 340 | | | | d=3a |
| 18MnMoNbR | Normalisation plus Tempering | 30-60 | 570-720 | 400 | 17 | 0 | 41 | d=3a |
| >60-100 | | 390 | | | | | | |
| 13MnNiMoR | | 30-100 | 570-720 | 390 | 18 | 0 | 41 | d=3a |
| | | >100-150 | | 380 | | | | |
| 15CrMoR | | 6-60 | 450-590 | 295 | 19 | 20 | 31 | d=3a |
| | | >60-100 | | 275 | | | | |
| | | >100-150 | 440-580 | 255 | | | | |
| 14Cr1MoR | | 6-100 | 520-680 | 310 | 19 | 20 | 34 | d=3a |
| | | >100-150 | 510-670 | 300 | | | | |
| 12Cr2Mo1R | | 6-150 | 520-680 | 310 | 19 | 20 | 34 | d=3a |
| 12Cr1MoVR | 6-60 | 440-590 | 245 | 19 | 20 | 34 | d=3a | |
| | >60-100 | 430-580 | 235 | | | | | |

^a – The yielding strength can be $R_{p0.2}$, if the yielding is not noticeable.

Table 3 – High Temperature Mechanical Performance

| Code | Thickness mm | Test Temperature °C | | | | | | |
|-----------|-----------------|---|-----|-----|-----|-----|-----|-----|
| | | 200 | 250 | 300 | 350 | 400 | 450 | 500 |
| | | Yielding Strength ^a R _{eL} or R _{p0.2} , N/mm ² , not less than | | | | | | |
| Q245R | >20-36 | 186 | 167 | 153 | 139 | 129 | 121 | |
| | >36-60 | 178 | 161 | 147 | 133 | 123 | 116 | |
| | >60-100 | 164 | 147 | 135 | 123 | 113 | 106 | |
| | >100-150 | 150 | 135 | 120 | 110 | 105 | 95 | |
| Q345R | >20-36 | 255 | 235 | 215 | 200 | 190 | 180 | |
| | >36-60 | 240 | 220 | 200 | 185 | 175 | 165 | |
| | >60-100 | 225 | 205 | 185 | 175 | 165 | 155 | |
| | >100-150 | 220 | 200 | 180 | 170 | 160 | 150 | |
| | >150-200 | 215 | 195 | 175 | 165 | 155 | 145 | |
| Q370R | >20-36 | 290 | 275 | 260 | 245 | 230 | | |
| | >36-60 | 280 | 270 | 255 | 240 | 225 | | |
| 18MnMoNbR | 30-60 | 360 | 355 | 350 | 340 | 310 | 275 | |
| | >60-100 | 355 | 350 | 345 | 335 | 305 | 270 | |
| 13MnNiMoR | 30-100 | 355 | 350 | 345 | 335 | 305 | | |
| | >100-150 | 345 | 340 | 335 | 325 | 300 | | |
| 15CrMoR | >20-60 | 240 | 225 | 210 | 200 | 189 | 179 | 174 |
| | >60-100 | 220 | 210 | 196 | 186 | 176 | 167 | 162 |
| | >100-150 | 210 | 199 | 185 | 175 | 165 | 156 | 150 |
| 14Cr1MoR | >20-150 | 255 | 245 | 230 | 220 | 210 | 195 | 176 |
| 12Cr2Mo1R | >20-150 | 260 | 255 | 250 | 245 | 240 | 230 | 215 |
| 12Cr1MoVR | >20-100 | 200 | 190 | 176 | 167 | 157 | 150 | 142 |

^a – The yielding strength can take R_{p0.2}, if the yielding is not noticeable.

7 Test Method

7.1 The test items, sample numbers, sampling methods and test methods for each batch of steel plate should conform to the requirements of Table 4.

Table 4 – Test Item, Sample Number and Test Method

| Serial Number | Test Item | Sample Number | Sampling Method | Sampling Direction | Test Method |
|---------------|--------------------------|---------------|-----------------|--------------------|---|
| 1 | Chemical Content | 1 per furnace | GB/T 20066 | | GB/T 223 or GB/T 4336 |
| 2 | Tensile Test | 1 | GB/T 2975 | Transverse | GB/T 228 |
| 3 | Z Direction Tensile | 3 | GB/T 5313 | | GB/T 5313 |
| 4 | Bending Test | 1 | GB/T 2975 | Transverse | GB/T 232 |
| 5 | Impact Test | 3 | GB/T 2975 | Transverse | GB/T 229 |
| 6 | High Temperature Tensile | 1 per furnace | GB/T 2975 | Transverse | GB/T 4338 |
| 7 | Drop-weight Test | | GB/T 6803 | | GB/T 6803 |
| 8 | Ultrasonic Test | Each Sheet | | | GB/T 2970 or JB/T 4730.3 |
| 9 | Dimension, Shape | Each Sheet | | | Measuring instrument with required accuracy |
| 10 | Furnace | Each Sheet | | | Visual Check |

8. Inspection Rules

- 8.1 The quality of steel plates should be inspected and accepted by the quality control department of the supplier.
- 8.2 The steel plates should be inspected in batches. Each batch is made up of steel plates with the same code, from the same furnace, with the same thickness, produced using the same rolling or heat treatment method and the weight of each batch is less than 30 tons.
Steel plate factories with a long, stable production quality history after submitting the application with the final product inspection data, and having been approved by the national special equipment safety inspection and supervision authority, can deliver goods according to the approved batch extension.
- 8.3 According to the buyer's requirements and the agreement between the buyer and the seller the mechanical performance test on the pre-forming rolling can be carried out on steel plates with a thickness greater than 16 mm.
- 8.4 The sampling position for the mechanical performance test is taken according to GB/T 2975. The axis of the impact test sample should be at a quarter of the plate's thickness. According to the buyer's requirements and the agreement between the buyer and the seller the axis of the impact test sample may be at half of the plate's thickness.
- 8.5 If the Charpy (V-type notch) test result does not meet the requirements of 6.4.1.2, another three samples from the same steel plate (or the same pre-formed product) could be taken for a repeat test. The average value of these six samples from the first and second groups should be no lower than the specified value but two of them may be lower than the specified value on condition that only one of these two is 70% lower than the specified value.
- 8.6 Other repeat tests and their method of determination are carried out according to the relevant provisions of GB/T 17505.

9 Packaging, Marking and Quality Certification

The packaging, marking and quality certification of steel plates should conform to the requirements of GB/T 247.

Appendix A
(Information appendix)

Code Correlation Table of New and Old Standards

The code correlation between GB 713-200X with GB 713-1997 and GB 6654-1996
(including corrigenda Nos 1 and 2) is as follows:

| GB 713-200X | GB 713-1997 | GB 6654-1996 |
|-------------|---------------|--------------|
| Q245R | 20g | 20R |
| Q345R | 16Mng, 19Mng | 16MnR |
| Q370R | | 15MnNbR |
| 18MnMoNbR | | 18MnMoNbR |
| 13MnNiMoR | 13MnNiCrMoNbg | 13MnNiMoNbR |
| 15CrMoR | 15CrMog | 15CrMoR |
| 12Cr1MoVR | 12Cr1MoVg | |
| 14Cr1MoR | | |
| 12Cr2Mo1R | | |