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Language of the proceedings: EN

Title of invention:
HIGH-STRENGTH STEEL SHEET AND METHOD FOR MANUFACTURING SAME

Patent Proprietor:
JFE Steel Corporation

Opponent:
Gudat, Axel

Headword:
High-strength steel sheet/JFE Steel

Relevant legal provisions:

EPC Art. 56
RPBA 2020 Art. 13(2)

Keyword:

Inventive step - Main request, Auxiliary request 1 (no) - Auxiliary request 2 (yes)
Amendment after notification of Art. 15(1) RPBA communication - exceptional circumstances (no)

Decisions cited:

Catchword:

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0

Case Number: T 1356/23 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 24 January 2025

Appellant: (Opponent)	Gudat, Axel Zehntweg 48 51467 Bergisch Gladbach (DE)
Respondent: (Patent Proprietor)	JFE Steel Corporation 2-3, Uchisaiwaicho 2-chome Chiyoda-ku Tokyo 100-0011 (JP)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 23 May 2023 rejecting the opposition filed against European patent No. 3255168 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	E. Bendl
Members:	S. Besselmann
	S. Fernández de Córdoba

Summary of Facts and Submissions

I. The appeal lies from the opposition division's decision to reject the opposition against European patent EP 3 255 168 B1.

II. The patent in suit relates to a high-strength steel sheet and to a method for manufacturing same.

III. Claim 1 of the patent as granted (main request) reads as follows, with feature labelling "M4" and "M5" added as referred to by the parties.

"*A high-strength steel sheet comprising*
a composition containing, by mass,
C: 0.02% or more and less than 0.10%
Si: less than 0.10%,
Mn: 0.2% or more and less than 1.0%,
P: 0.10% or less,
S: 0.020% or less,
Al: 0.01 % or more and 0.10% or less,
N: 0.010% or less,
Nb: 0.005% or more and less than 0.070%,
optionally one or more elements selected from
Cr: 0.3% or less,
Mo: 0.3% or less,
B: 0.005% or less,
Cu: 0.3% or less, and
Ni: 0.3% or less, and
the balance being Fe and inevitable impurities, and
a microstructure including, by area,
ferrite: 90% or more,
pearlite: 0% to 10%, and
the total of martensite, retained austenite, and
cementite: 0% to 3%,

[M4] wherein an average crystal grain diameter d_C of the ferrite at the center of the steel sheet in the width direction is 15.0 µm or less,

[M5] wherein a difference between an average crystal grain diameter d_E of the ferrite at a position 100 mm from an edge of the steel sheet in the width direction toward the center of the steel sheet and the average crystal grain diameter d_C is 5.0 µm or less,

wherein the area fraction of each microstructure is determined by a point-count method described in ASTM E562-05, and
wherein the average diameter of the ferrite crystal grains is determined by SEM observation."

IV. Claim 1 according to auxiliary request 1 differs from that of the main request in that the following phrase has been added to the end of the claim:
"*, and wherein the high-strength steel sheet has a tensile strength of 330 MPa or more and less than 500 MPa*".

V. Claim 1 according to auxiliary request 2 differs from that of auxiliary request 1 in that the following phrase has been added to the end of the claim:
"*, and wherein the high-strength steel sheet is provided with a hot-dip galvanizing layer disposed on its surface*".

Claim 3 relates to a method for producing the high-strength steel sheet according to claim 1. Claims 2 and 4 are dependent on claims 1 and 3, respectively.

VI. The following documents are relevant here.
D2 EP 2 138 596 A1

D3	EP 2 752 500 A1
D8	EP 0 432 498 A2
D10	GB 2 041 241 A

VII. The opponent's (now appellant's) arguments relevant to the present decision can be summarised as follows.

The subject-matter of the main request lacked, *inter alia*, an inventive step in view of D2 as the closest prior art. This also applied to auxiliary request 1.

The subject-matter of auxiliary request 2 also lacked an inventive step. In this regard, the submissions of 25 November 2024, in which D10 was cited and an objection of lack of inventive step starting from D3 was raised, were to be taken into account. These submissions were a reaction to the board's preliminary opinion. Moreover, D10 merely reflected common general knowledge, and D3 already formed part of the proceedings. The subject-matter of auxiliary request 2 also lacked an inventive step starting from D2 as the closest prior art, taken in combination with common general knowledge, D3 or D8.

VIII. The patent proprietor's (now respondent's) arguments relevant to the present decision can be summarised as follows.

The subject-matter of the main request involved an inventive step. Starting from D2, the technical problem was to not only provide an improved, i.e. lower, tensile-strength variation in the width direction of the steel sheet, but also an improved yield ratio. The skilled person would not have consulted D3 to solve the stated problem. Even if they had done, they would not have found any relevant teaching in the prior art to provide features M4 and M5 (see point III.) in the claimed steel sheets.

This also applied to auxiliary request 1.

The appellant's submissions citing D10 and using D3 as the closest prior art were filed late and were not to be taken into account. The subject-matter of auxiliary request 2 involved an inventive step because the skilled person would not have applied a hot-dip galvanized layer to a steel sheet for a can.

IX. The appellant requests that the decision under appeal be set aside and that the patent be revoked.

The respondent requests that the appeal be dismissed (main request) or, alternatively, that the patent be maintained in amended form on the basis of one of auxiliary requests 1-37 filed with the reply to the grounds of appeal, or on the basis of one of auxiliary requests 38-70 filed on 17 January 2025.

Reasons for the Decision

Main request

1. Inventive step

1.1 The patent in suit relates to a high-strength steel sheet (paragraph [0001]).

1.2 It was common ground that D2 was a suitable starting point for assessing inventive step. D2 relates to a steel sheet for a can having, *inter alia*, high strength (paragraph [0001]). The steel sheet has a relevant chemical composition and microstructure (see examples of Levels no. 3-6, in particular Level no. 3).

1.3 The patent in suit addresses the technical problem of providing a high-strength steel sheet having an improved combination of tensile-strength variation in the width direction of the steel sheet and yield ratio of the steel sheet (paragraphs [0009] and [0061]).

1.4 As the solution to this technical problem, the high-strength steel sheet according to claim 1 is proposed. In the respondent's favour, it is assumed that M4 and M5 (see below) are the distinguishing features - M4 insofar as D2 does not specify where the average crystal grain diameter of ferrite indicated in D2 has been measured.

(M4) *wherein an average crystal grain diameter* d_C *of the ferrite at the center of the steel sheet in the width direction is 15.0 µm or less*,

(M5) *wherein a difference between an average crystal grain diameter* d_E *of the ferrite at a position 100 mm from an edge of the steel sheet in the width direction toward the center of the steel sheet and the average crystal grain diameter* d_C *is 5.0 µm or less.*

1.5 The respondent was of the view that both aspects of the indicated technical problem (see point 1.3 above) were successfully solved, i.e. not only was improved uniformity of the tensile strength obtained, but also a better yield ratio of the steel sheet, compared with D2. They argued that the examples and comparative examples in the patent in suit demonstrated that the yield ratio depended on the coiling temperature. This could be seen in (Comparative) Examples 14-17, which all related to the same alloy (Table 2). In Comparative Example 17, the coiling temperature was too high and the yield ratio was thus too low. The examples of Levels no. 5 and 6 in D2 likewise involved too high a coiling temperature (Table 2), which consequently led to too low a yield ratio.

1.6 However, the patent in suit associates the tensile strength and yield ratio with the microstructure of the material (paragraph [0061]). In Comparative Example 17 of the patent in suit, the average crystal grain diameter of the ferrite is 15.8 µm, which is outside the claimed range. The known steel sheets of Levels No. 4-6 in D2, by contrast, all have an average crystal grain diameter within the claimed range (5.0 µm in the case of Level no. 3, 5.5 µm in the case of Level no. 4, 6.0 µm in the case of Levels no. 5 and 6; see Table 3 in D2), and those of Levels no. 3 and 4 are even produced using a coiling temperature within the range taught in the patent in suit (paragraph [0016]). What is unknown is merely whether the microstructure has been measured at the centre of the steel sheet, which may affect the location in the steel sheet at which the associated mechanical properties are obtained. Given that the known steel sheets thus already exhibit the required microstructure, the associated effects, namely the tensile strength and the yield ratio, cannot be used to formulate the objective technical problem. The distinguishing features, relating to the location and uniformity across the width, can merely be associated with a more even distribution of these properties across the width of the sheet.

1.7 The objective technical problem can therefore be considered that of providing a high-strength steel sheet having reduced variability of the tensile strength in the width direction of the steel sheet.

1.8 The appellant cited D3 as a secondary document that would have guided the skilled person towards the claimed solution.

1.9 The respondent was of the view that the skilled person would not have consulted D3 to reach the desired combination of properties. The teaching of D2 and D3 could not be combined because D3 related to automobile parts whereas D2 related to steels for cans. Moreover, the respective steels differed in chemical composition, in particular in their Si and Mn contents, and also in their microstructures. Insofar as D3 mentioned the "variability of material quality" (paragraphs [0008] and [0009]), it was linked to the Si content (paragraph [0020]). According to the respondent, too, D3 only taught controlling the thermal history, and thus a variation over time, which had to be distinguished from controlling a variation across the width.

1.10 However, the skilled person would turn to D3 because it addresses a technical problem which is similar to the problem here, namely that of limiting the difference in tensile strength across the width of a steel sheet (paragraph [0010], point [2]), and specifically in the context of a related steel, i.e. a high-strength steel sheet (paragraph [0008]).

1.11 Specifically, D3 teaches limiting the difference in the tensile strength between the centre of the width of the hot-rolled strip and a position near the edge (1/8 of the width from the edge) to 30 MPa or less (paragraph [0010], point [2]). In contrast to the respondent's view, limiting this difference across the width forms part of the more general aim of keeping the variability of the material quality in the cold-rolled sheet low (paragraph [0009]). The variability of the material quality is not merely presented as a question of the Si content in the steel, but is expressly linked to the thermal history of the steel sheet (ibid.).

Specifically, D3 teaches controlling the microstructure formed at the coiling stage (mainly ferrite and pearlite) and the mean grain sizes and area ratios (paragraph [0009]) by controlling the thermal history from a finish-rolling delivery temperature to a coiling temperature. Tensile strength is explicitly associated with the grain size of ferrite and the coiling temperature (paragraphs [0060] and [0061]).

D3 does not expressly link the variability of the material quality *across the width* of the steel sheet to *variability* of the microstructure or the thermal history *across the width* of the steel sheet, but this link would be readily apparent to the skilled person. Indeed, it would be illogical to control the thermal history, in particular the coiling temperature, and thus the microstructure across only a small portion of the width, given that the aim is reduced variability of the tensile strength across that width. While the reference to thermal history certainly involves a time component, as argued by the respondent, the skilled person would thus immediately derive from D3 that controlling the variability of the thermal history, in particular the coiling temperature, across the width of the steel sheet makes it possible to control the microstructure and ultimately the variability of the tensile strength across that width.

1.12 This teaching in D3 would have prompted the skilled person to consider possible variability of the tensile strength across the width in the case of the steel sheets known from D2, too, and to ensure that it is low. This consideration is so general in nature that there is no incompatibility between the teaching of D2 and D3 with regard to the relevance and applicability of this consideration. It is not only independent of the intended use of the steel sheet, but also of the specific area fraction of ferrite, the contents of alloying metals present (the silicon and manganese contents being different in D2 and D3) and the precise value of the tensile strength.

1.13 Furthermore, the tensile strength is a parameter of interest in D2 (paragraph [0001]; Table 3). The skilled person would naturally regard it as desirable that this property is uniform across the width of the sheet, and that the measured value (Table 3) is representative of the sheet in question as a whole, and not merely of a small portion of it.

At the same time, the skilled person learns from D2 itself how the processing conditions affect the tensile strength and the average crystal grain size of a given steel; see examples of Levels no. 3-6 (Tables 1 to 3; see also the summary provided by the appellant, statement of grounds of appeal, page 4), all of which have the same chemical composition of the steel.

It is apparent that the variability of the tensile strength between different samples subjected to different coiling temperatures (550°C, 640°C and 720°C, respectively) is between 520 and 490 MPa. At the same time, the average crystal grain size only varies between 5.0 and 6.0 µm.

According to the respondent, it was not possible to derive a relationship between these parameters because other parameters had also been varied; however, the coiling temperature is explicitly described as an "important factor for controlling the strength, the ductility ..." (paragraph [0048] of D2) and constitutes the parameter that has been varied to the greatest extent in the examples. When comparing Level no. 3 and Level no. 4, it is apparent that only the coiling temperature has been changed, with the cooling rate being adapted, as argued by the appellant. When comparing Level no. 5 and Level no. 6, it is apparent that the differences did not affect the tensile strength or the average crystal grain diameter.

Even without establishing a strict relationship, it can thus be derived from D2 that the variability of the tensile strength (30 MPa) and the average crystal grain size (1.0 µm) with the coiling temperature is low across the rather broad coiling-temperature interval (170°C) considered. This temperature interval is in fact greater than the highest temperature variation across the width found in a *comparative* example in the patent in suit (100°C, Table 2, No. 21), which the skilled person could therefore implement without any particular effort.

In the light of the above, the skilled person aiming to obtain a uniform tensile strength across the width of the steel sheet would ensure that the process conditions, in particular the coiling temperature, and consequently the average crystal grain diameter of ferrite were uniform across the width of the steel sheet. As indicated, the skilled person would easily keep the coiling-temperature variation *below* the range covered by the examples in D2. It can reasonably be concluded that they would consequently keep the *variability* of the average crystal grain diameter within the range of up to 5.0 µm stipulated in the claim, which is five times the variability that can be estimated on the basis of the examples in D2. This is all the more so as D2 teaches an average crystal grain size of preferably 4 to 7 µm (claim 3), which the skilled person would attempt to achieve across the width of the steel sheet.

The skilled person applying this to the production of a steel sheet having a conventional width, and aiming to obtain one of the average crystal grain diameters exemplified in Levels no. 3-6 in D2, would thus arrive at a steel sheet which meets the requirements regarding the location and variability of the crystal grain diameter (features M4 and M5) in a straightforward manner.

1.14 The subject-matter of claim 1 therefore does not involve an inventive step.

Auxiliary request 1

2. The objection of lack of inventive step set out for the main request also applies to claim 1 of auxiliary request 1, considering that the upper limit of the tensile strength of less than 500 MPa does not provide any additional distinction from the examples in D2 under consideration, in which a tensile strength of 490 MPa has been exemplified (Levels no. 5-6).

The subject-matter of claim 1 therefore lacks an inventive step.

Auxiliary request 2

3. Consideration of submissions

3.1 In its preliminary opinion, in the appellant's favour, the board took the appellant's comments on claim 2 as granted into account when dealing with claim 1 of auxiliary request 2, in which the features of claim 2 had been incorporated. According to said comments by the appellant, providing a hot-dip galvanizing layer was a usual measure for the applications concerned, as was apparent in D3 or D8, and the claimed subject-matter at least lacked an inventive step (statement of grounds of appeal, point II.3.1.). These comments were a continuation of the objection of lack of inventive step raised by the appellant against claim 1 as granted, which relied on D2 as the closest prior art (point II.2 of the statement of grounds of appeal).

3.2 The appellant only presented fresh lines of reasoning addressing auxiliary request 2 in reply to the board's preliminary opinion (appellant's submission of 25 November 2024). These lines of reasoning were an objection relying on the newly filed D10 as alleged common general knowledge to be combined with D2, and an objection of lack of inventive step starting from document D3 as the closest prior art. They cannot be regarded as a refinement of the appellant's initial comments made against claim 2 as granted (see point 3.1). Moreover, by contrast with the appellant's view, D10 is a patent document and as such does not represent common general knowledge. The introductory part of D10, on which the appellant relied, does not even describe zinc plating as a known measure for steel for cans, but presents it as the disclosed invention (D10, page 1, left-hand column, in particular lines 6-10 and 52-59). D10 is therefore a fresh secondary document to be combined with D2. Furthermore, using D3 as an alternative starting point and not as a secondary document clearly amounts to an entirely different objection, leading to other distinguishing features and a different formulation of the objective technical problem.

3.3 As indicated, the appellant's line of reasoning using D10 as well as that starting from D3 as the closest prior art were submitted only after the board's communication pursuant to Article 15(1) RPBA had been notified. Therefore, the provisions of Article 13(2) RPBA apply.

According to these provisions any amendment shall, in principle, not be taken into account unless there are exceptional circumstances, which have been justified with cogent reasons by the party concerned.

According to the appellant, their lines of reasoning constituted a reaction to the board's preliminary opinion, in which it had been found that "there is no convincing argument why hot-dip galvanizing would be conventional in steels for cans, which is the only application considered in D2" (point 13.2 of the communication dated 9 September 2024). However, this remark merely demonstrated that the board had been unable to identify any such argument in the appellant's submissions, but this does not provide any justification for the appellant to supply such arguments at a later stage.

3.4 For these reasons, the board cannot identify any exceptional circumstances for taking the appellant's indicated, late-filed lines of reasoning into account. Consequently, they are to be disregarded.

4. Inventive step

4.1 The appellant's only objection is consequently that of a lack of inventive step starting from D2 as the closest prior art, as set out for the main request, and taking the teaching of hot-dip galvanizing in D3 (title and paragraph [0062]) and D8 (page 17, lines 25 ff) into account.

4.2 Reference is therefore made to the comments regarding the main request and auxiliary request 1.

4.3 Claim 1 additionally differs from D2 in that the high-strength steel sheet is provided with a hot-dip galvanizing layer disposed on its surface.

4.4 In the appellant's favour, their view is accepted insofar as the partial technical problem associated with this difference is considered that of providing improved, i.e. active, corrosion inhibition of the steel, compared with the chromium plating known from D2.

4.5 While hot-dip galvanizing as such is generally known and provides active corrosion inhibition, it needs to be assessed whether it would have been obvious for the skilled person to implement this measure in the steel known from D2.

4.6 According to the appellant, it had already been established for the main request that the teaching of D2 and D3 could be combined. Accordingly, the skilled person would also have applied the hot-dip galvanizing step known from D3 (title and paragraph [0062]) to the steel sheets from D2. The appellant was also of the view that the skilled person would readily recognise that the steel for cans which were known from D2 could alternatively be used for fabricating automobile parts, and that the skilled person would provide a hot-dip galvanized layer for this purpose, motivated by the teaching in D3 (title and paragraph [0062]) and D8 (page 17, lines 25 ff).

4.7 However, the teaching in D3 that is relevant to the main request (regarding possible variability of the tensile strength across the width of the steel sheet) is very general in nature, and has been found to be independent of the intended use of the steel sheet, the specific area fraction of ferrite, etc., as outlined above (point 1.12). This is not comparable to the question at issue here, namely whether a specific treatment step from D3 would be applied to the steel sheet from D2.

D2 *exclusively* deals with steel for cans (paragraph [0001] and claim 1). It discloses chromium plating for corrosion inhibition (paragraph [0054]). This results in thin, smooth and mirror-like plating, i.e. a different look and quality from hot-dip galvanizing. Said result can be relevant, for instance, with regard to a subsequent lacquer-finishing step of the can, which is disclosed as a method step in D2 (paragraph [0017]). While chromium plating and hot-dip galvanizing are both tin-free measures for corrosion inhibition, they thus cannot be regarded as equivalent alternatives in the context of D2.

There is no evidence on file that hot-dip galvanizing would be a common replacement for chromium plating in cans.

D3 (title and paragraph [0062]) and D8 (page 17, lines 25 ff) do mention hot-dip galvanizing, but the respective disclosures relate in particular to steel for automobile parts (D3, paragraph [0001]; D8, page 17, lines 29-30). Neither D3 nor D8 suggests hot-dip galvanizing of a steel for use in a can.

4.8 By contrast with the appellant's view, there is no teaching in any of D2, D3 and D8 that would suggest to the skilled person that a steel for a can should be adapted for use as an automobile part. It is not the case either that the steel sheets in these documents would be identical, which might point to the same possible application. Instead, the steel sheets differ with regard to their microstructure, for instance. On the one hand, in D2, the steel sheet has a ferrite single phase structure having an average grain size of 7 µm or less (see claim 1 in D2), and on the other hand, in D3, it has an area fraction of ferrite of 75-95% and an average crystal grain diameter of 5 µm to 25 µm (claim 1), and in D8 an area fraction of ferrite of 95% or more and an average crystal grain diameter of 20 µm or less (claim 1).

4.9 In conclusion, there is no convincing argument as to why the skilled person would apply a hot-dip galvanizing step to the steel sheets for a can, as are known from D2.

4.10 The subject-matter of claim 1 therefore involves an inventive step.

4.11 The same conclusion applies to claim 3, which relates to a method for producing the high-strength steel sheet according to claim 1, and to claims 2 and 4, which are dependent on claims 1 and 3, respectively.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the opposition division with the order to maintain the patent according to the claims of the auxiliary request 2 submitted with the reply to the statement of grounds of appeal and a description to be adapted thereto.

The Registrar: The Chairman:

Beschwerdekammern des Europäischen Patentamts
Boards of Appeal of the European Patent Office
Chambres de recours de l'Office européen des brevets

C. Vodz E. Bendl

Decision electronically authenticated