Mn	0.48	0.56
Cr	13.1	13.4
Mo	0.98	0.99
N	0.017	0.052
V	0.009	0.055
Ni	0.31	0.15
P	0.018	0.018
S	0.0004	0.0006

Fe and impurities balance.

The cold rolled strips used for the hardening and tempering trials all had a thickness of 0.203 mm and a width of 140 mm. The strips were subjected to hardening and tempering in the above mentioned continuous hardening furnace. Tensile strength measurements were made according to ISO 6892:2009. Fig. 1 discloses tensile properties as a function of the austenitising temperature. Fig. 2 discloses the tensile properties as a function of the tempering temperature.

ADDITIONAL EXAMPLES

Example 1 relates to a cold rolled and hardened martensitic/austenitic stainless steel strip for flapper valves in the compressors, wherein the steel strip

a) is made from steel consisting of in weight % (wt. %):

C	0.3 – 0.5
Si	0.2 – 0.8
Mn	0.2 – 1.0
Cr	12.0 – 15.0
Mo	0.5 – 2.0
N	0.02 – 0.15
V	0.01 – 0.20
Ni	$\leq$ 2.0
Co	$\leq$ 2.0

Cu	≤ 2.0
W	≤ 2.0
Al	≤ 0.06
Ti	≤ 0.05
Zr	≤ 0.05
Nb	≤ 0.05
Ta	≤ 0.05
B	≤ 0.01
Ca	≤ 0.009
REM	≤ 0.2

Fe and impurities balance,

b) has a matrix consisting of tempered martensite and between 5 and 15 volume % austenite,

c) has a tensile strength (R_m) of 1970-2300 MPa,

d) has a thickness of 0.07 - 3 mm and a width of $\leq$ 500 mm.

Example 2 relates to the strip according to example 1, the strip fulfilling at least one of the following requirements:

C	0.35 – 0.41
Si	0.30 – 0.60
Mn	0.40 – 0.65
Cr	13 – 14
Mo	0.8 – 1.2
N	0.03 – 0.13
V	0.02 – 0.10
Ni	≤ 0.5
Co	≤ 0.5
Cu	≤ 0.5
W	≤ 0.5
Al	≤ 0.01
Ti	≤ 0.01
Zr	≤ 0.01
Nb	≤ 0.01

Ta	≤ 0.01
B	≤ 0.001
Ca	$0.0005 - 0.002$

and wherein the impurity contents of P, S and O fulfils the following requirements

P	≤ 0.03
S	≤ 0.03
O	≤ 0.003

Example 3 relates to the strip according to example 1 or 2, the strip fulfilling the following requirements:

C	$0.35 - 0.41$
Si	$0.30 - 0.60$
Mn	$0.40 - 0.65$
Cr	$13 - 14$
Mo	$0.8 - 1.2$
N	$0.03 - 0.10$
V	$0.03 - 0.09$

Example 4 relates to the strip according to any of examples 1 - 3, the strip fulfilling at least one of the following requirements: a tensile strength (R_m) of 2000-2200 MPa, a yield strength ($R_{P0.2}$) of 1500-1750 MPa, a Vickers Hardness (HV1) of 570 - 650, a ductility A50 of 4-9 %.

Example 5 relates to the strip according to any of examples 1 - 4, the strip fulfilling the following requirements: reverse bending fatigue is > 850 MPa.

Example 6 relates to the strip according to any of examples 1 - 5, the strip having a thickness of 0.1 - 1.5 mm and/or a width of 5 - 150 mm.

Example 7 relates to the strip according to any of examples 1 - 6, wherein the maximum globular inclusion size is 6 μm.

Example 8 relates to the strip according to any of examples 1 - 7, wherein the primary inclusion species are Silicate type with a maximum width of 4 μm.

Example 9 relates to a method of producing a strip according to any of examples 1 - 8, wherein the method comprises the following steps:

a) Hot rolling a steel having a composition as defined in any of examples 1-3,

b) Cold rolling the hot rolled strip to a thickness of 0.07-3mm,

c) Continuously hardening and tempering the cold rolled strip,

d) Optionally, slitting the cold rolled strip.

Example 10 relates to the method according to example 9, wherein the austenitising temperature is 1000 - 1150 °C in step c) and wherein tempering temperature is 200 - 600 °C.

Example 11 relates to the method according to example 9 or 10, wherein the hardening involves quenching the strip in a bath of molten lead or lead alloy, the bath preferably holding a temperature of 250 - 350 °C.

Example 12 relates to the method according to any one of examples 9 - 11, wherein the steel used is produced by powder metallurgy and wherein the maximum globular inclusion size of said steel is 6 μm.

INDUSTRIAL APPLICABILITY

The inventive steel strip can be used for producing flapper valves for compressors having improved properties.

CLAIMS

1. A cold rolled and hardened martensitic/austenitic stainless steel strip for flapper valves in the compressors, wherein the steel strip

a) is made from steel consisting of in weight % (wt. %):

C	0.3 – 0.5
Si	0.2 – 0.8
Mn	0.2 – 1.0
Cr	12.0 – 15.0
Mo	0.5 – 2.0
N	0.02 – 0.15
V	0.01 – 0.20
Ni	$\leq$ 2.0
Co	$\leq$ 2.0
Cu	$\leq$ 2.0
W	$\leq$ 2.0
Al	$\leq$ 0.06
Ti	$\leq$ 0.05
Zr	$\leq$ 0.05
Nb	$\leq$ 0.05
Ta	$\leq$ 0.05
B	$\leq$ 0.01
Ca	$\leq$ 0.009
REM	$\leq$ 0.2

Fe and impurities balance,

b) has a matrix consisting of tempered martensite and between 5 and 15 volume % austenite,

c) has a tensile strength (R_m) of 1970-2300 MPa,

d) has a thickness of 0.07 - 3 mm and a width of < 500 mm.

2. A strip according to claim 1 fulfilling at least one of the following requirements:

C	0.35 – 0.41
Si	0.30 – 0.60
Mn	0.40 – 0.65
Cr	13 – 14
Mo	0.8 – 1.2
N	0.03 – 0.13
V	0.02 – 0.10
Ni	≤ 0.5
Co	≤ 0.5
Cu	≤ 0.5
W	≤ 0.5
Al	≤ 0.01
Ti	≤ 0.01
Zr	≤ 0.01
Nb	≤ 0.01
Ta	≤ 0.01
B	≤ 0.001
Ca	0.0005 – 0.002

and wherein the impurity contents of P, S and O fulfils the following requirements

P	≤ 0.03
S	≤ 0.03
O	≤ 0.003

3. A strip according to claim 1 or 2 fulfilling the following requirements:

C	0.35 – 0.41
Si	0.30 – 0.60
Mn	0.40 – 0.65
Cr	13 – 14
Mo	0.8 – 1.2
N	0.03 – 0.10
V	0.03 – 0.09

4. A strip according to any of the preceding claims, fulfilling at least one of the following requirements:

a tensile strength (R_m) of 2000-2200 MPa,

a yield strength ($R_{P0.2}$) of 1500-1750 MPa,

a Vickers Hardness (HV1) of 570 - 650,

a ductility A50 of 4-9 %.

5. A strip according to any of the preceding claims, fulfilling the following requirements:

reverse bending fatigue is > 850 MPa.

6. A strip according to any of the preceding claims having a thickness of 0.1 - 1.5 mm and/or a width of 5 - 150 mm.

7. A strip according to any of the preceding claims, wherein the maximum globular inclusion size is 6 µm.

8. A strip according to any of the preceding claims, wherein the primary inclusion species are Silicate type with a maximum width of 4 μm.

9. A method of producing a strip according to any of claims 1-8, wherein the method comprises the following steps:

a) Hot rolling a steel having a composition as defined in any of claims 1-3,

b) Cold rolling the hot rolled strip to a thickness of 0.07-3mm,

c) Continuously hardening and tempering the cold rolled strip,

d) Optionally, slitting the cold rolled strip.

10. A method according to claim 9, wherein the austenitising temperature is 1000 - 1150 °C in step c) and wherein tempering temperature is 200 - 600 °C.

11. A method according to claim 9 or 10, wherein the hardening involves quenching the strip in a bath of molten lead or lead alloy, the bath preferably holding a temperature of 250 - 350 °C.

12. A method according to any of claims 9-11, wherein the steel used is produced by powder metallurgy and wherein the maximum globular inclusion size of said steel is 6 μm.