Claims

1. A hot work tool steel for hot forging, press hardening, die casting or hot extrusion consisting of in weight % (wt.%):

C	0.5 - 0.9
Si	0.03 - 0.8
Mn	0.1 - 1.8
Cr	4.0 – 6.6
Mo	1.8 – 3.5
V	1.3 - 2.3
Al	≤ 0.1
N	≤ 0.12
Ni	≤ 1
W	≤ 1
Co	≤ 5
Cu	≤ 1
Nb	≤ 0.1
Ti	≤ 0.05
Zr	≤ 0.05
Ta	≤ 0.05
B	≤ 0.01
Ca	≤ 0.01
Mg	≤ 0.01
REM	≤ 0.2

balance Fe and impurities.

2. A hot work tool steel according to claim 1, wherein the steel fulfils at least one of the following requirements:

C	0.6 - 0.8
Si	0.05 - 0.6

Mn	0.2 - 0.8
Cr	4.4 – 5.6
Mo	2.0 – 2.5
V	1.5 - 1.9
Al	≤ 0.05
N	≤ 0.08
Ni	≤ 0.5
W	≤ 0.5
Co	≤ 2
Cu	≤ 0.5
Nb	≤ 0.05
Ti	≤ 0.01
Zr	≤ 0.01
Ta	≤ 0.01
B	≤ 0.006
Ca	≤ 0.005
Mg	≤ 0.005
REM	≤ 0.1

3. A hot work tool steel according to claim 1 or 2, wherein the steel fulfils at least one of the following requirements:

C	0.65 - 0.75
Si	0.15 - 0.5
Mn	0.4 - 0.5
Cr	4.9 – 5.1
Mo	2.2 – 2.3
V	1.5 - 1.7
Al	≤ 0.03
N	≤ 0.05
Ni	0.25
W	≤ 0.2

Co	≤ 1
Cu	≤ 0.2
Nb	≤ 0.005
Ti	≤ 0.005
Zr	≤ 0.005
Ta	≤ 0.005
REM	≤ 0.05

4. A hot work tool steel according to any of the preceding claims, wherein the steel comprises carbides having a size of ≥ 1 µm and fulfils at least one of the following requirements concerning the amounts of carbides in volume %:

VC	0.2 – 4
M_6C	≤ 2
M_7C_3	≤ 2

5. A hot work tool steel according to claim 4, wherein the steel comprises carbides having a size of ≥ 1 µm and fulfils at least one of the following requirements concerning the amounts of carbides in volume %:

VC	0.5 – 3
M_6C	≤ 0.5
M_7C_3	≤ 0.5

6. A hot work tool steel according to claim 5, wherein the steel comprises carbides having a size of ≥ 1 µm and fulfils at least one of the following requirements concerning the amounts of said carbides in volume %:

VC	1.5 – 2.3
M_6C	≤ 0.1
M_7C_3	≤ 0.1

7. A hot work tool steel according to any of the preceding claims, wherein the steel after hardening and tempering has a hardness of 55-57 HRC and wherein the steel fulfils at least one of the following requirements:

Rp0.2	≥ 1750 MPa
Rm	≥ 2100 MPa
A5	≥ 6 %
Z	≥ 20 %

a cleanliness fulfilling the following maximum requirements with respect to micro-slag according to ASTM E45-97, Method A, Plate I-r:

A	A	B	B	C	C	D	D
T	H	T	H	T	H	T	H
1.0	0	1.5	1.0	0	0	1.5	1.0

8. A hot work tool steel according to any of the preceding claims, wherein the steel fulfils at least one of the following requirements:

C	0.66 - 0.75
Si	0.15 - 0.25
Mo	2.2 – 2.3
V	1.52 - 1.68
Al	0.001 - 0.03
N	≤ 0.05
W	≤ 0.1
Co	≤ 1
Cu	≤ 0.15
Nb	≤ 0.005
Ti	≤ 0.005
Zr	≤ 0.005

~~9. A steel according to any of claims 1-3, wherein the steel is soft annealed and has a mean hardness of ≤ 360 HBW, and wherein the steel has a thickness of at least 100 mm and the maximum deviation from the mean Brinell hardness value in the thickness direction measured in accordance with ASTM E10-01 is less than 10 %, preferably less than 5 %, and wherein the minimum distance of the centre of the indentation from the edge of the specimen or edge of another indentation shall be at least two and a half times the diameter of the indentation and the maximum distance shall be no more than 4 times the diameter of the indentation.~~

~~10. Use of a steel according to any of the preceding claims as a tool for hot forging, press hardening, die casting, high pressure die casting or hot extrusion.~~

~~AMENDED CLAIMS~~

~~received by the International Bureau on 26 August 2021 (26.08.2021)~~

Claims

1. A hot work tool steel for hot forging, press hardening, die casting or hot extrusion consisting of in weight % (wt.%):

C	0.65 - 0.85
Si	0.03 - 0.8
Mn	0.1 - 1.8
Cr	4.5 – 6.6
Mo	1.8 – 3.5
V	1.3 - 2.3
Al	≤ 0.1
N	≤ 0.12
Ni	≤ 1
W	≤ 0.5
Co	≤ 2
Cu	≤ 1
Nb	≤ 0.1
Ti	≤ 0.05
Zr	≤ 0.05
Ta	≤ 0.05
B	≤ 0.01
Ca	≤ 0.01
Mg	≤ 0.01
REM	≤ 0.2

balance Fe and impurities.

2. A hot work tool steel according to claim 1, wherein the steel fulfils at least one of the following requirements:

C	0.65 - 0.8
Si	0.05 - 0.6
Mn	0.2 - 0.8

Cr	4.5 – 5.6
Mo	2.0 – 2.5
V	1.5 - 1.9
Al	≤ 0.05
N	≤ 0.08
Ni	≤ 0.5
W	≤ 0.5
Co	≤ 2
Cu	≤ 0.5
Nb	≤ 0.05
Ti	≤ 0.01
Zr	≤ 0.01
Ta	≤ 0.01
B	≤ 0.006
Ca	≤ 0.005
Mg	≤ 0.005
REM	≤ 0.1

3. A hot work tool steel according to claim 1 or 2, wherein the steel fulfils at least one of the following requirements:

C	0.65 - 0.75
Si	0.15 - 0.5
Mn	0.4 - 0.5
Cr	4.9 – 5.1
Mo	2.2 – 2.3
V	1.5 - 1.7
Al	≤ 0.03
N	≤ 0.05
Ni	0.25
W	≤ 0.2
Co	≤ 1
Cu	≤ 0.2
Nb	≤ 0.005

Ti	≤0.005
Zr	≤0.005
Ta	≤0.005
REM	≤0.05

4. A hot work tool steel according to any of the preceding claims, wherein the steel comprises carbides having a size of ≥ 1 µm and fulfils at least one of the following requirements concerning the amounts of carbides in volume %:

VC	0.2 – 4
M_6C	≤ 2
M_7C_3	≤ 2

5. A hot work tool steel according to claim 4, wherein the steel comprises carbides having a size of ≥ 1 µm and fulfils at least one of the following requirements concerning the amounts of carbides in volume %:

VC	0.5 – 3
M_6C	≤ 0.5
M_7C_3	≤ 0.5

6. A hot work tool steel according to claim 5, wherein the steel comprises carbides having a size of ≥ 1 µm and fulfils at least one of the following requirements concerning the amounts of said carbides in volume %:

VC	1.5 – 2.3
M_6C	≤ 0.1
M_7C_3	≤ 0.1

7. A hot work tool steel according to any of the preceding claims, wherein the steel after hardening and tempering has a hardness of 55-57 HRC and wherein the steel fulfils at least one of the following requirements:

Rp0.2	≥ 1750 MPa
Rm	≥ 2100 MPa
A5	≥ 6 %
Z	≥ 20 %

a cleanliness fulfilling the following maximum requirements with respect to micro-slag according to ASTM E45-97, Method A, Plate I-r:

A	A	B	B	C	C	D	D
T	H	T	H	T	H	T	H
1.0	0	1.5	1.0	0	0	1.5	1.0

8. A hot work tool steel according to any of the preceding claims, wherein the steel fulfils at least one of the following requirements:

C	0.66 - 0.75
Si	0.15 - 0.25
Mo	2.2 – 2.3
V	1.52 - 1.68
Al	0.001 - 0.03
N	≤ 0.05
W	≤ 0.1
Co	≤ 1
Cu	≤ 0.15
Nb	≤ 0.005
Ti	≤ 0.005
Zr	≤ 0.005

9. A hot work tool steel according to any of the preceding claims, wherein the steel fulfils at least one of the following requirements:

C	0.66 - 0.75
Si	0.15 - 0.25

Mo	2.2 – 2.3
V	1.52 - 1.68
Al	0.005 - 0.03
N	≤ 0.05
W	≤ 0.1
Co	≤ 0.5
Cu	≤ 0.15
Nb	≤ 0.005
Ti	≤ 0.005
Zr	≤ 0.005

10. A steel according to any of claims 1-6 having a mean hardness of ≤ 360 HBW, wherein the steel has a thickness of at least 100 mm and the maximum deviation from the mean Brinell hardness value in the thickness direction measured in accordance with ASTM E10-01 is less than 10 %, preferably less than 5 %, and wherein the minimum distance of the centre of the indentation from the edge of the specimen or edge of another indentation shall be at least two and a half times the diameter of the indentation and the maximum distance shall be no more than 4 times the diameter of the indentation.

11. Use of a steel according to any of the preceding claims as a tool for hot forging, press hardening, die casting, high pressure die casting or hot extrusion.