Technical Data Sheet
UGI® 4362

Chemical analysis (%)

C	Si	Mn	Ni	Cr	Cu	Mo	N	P	S
≤0.030	≤1.0	≤2,0	3,5 – 5,5	22.0 – 24.0	0.1 – 0.6	0.1 – 0.6	0.05 – 0.20	≤0.035	≤0,015

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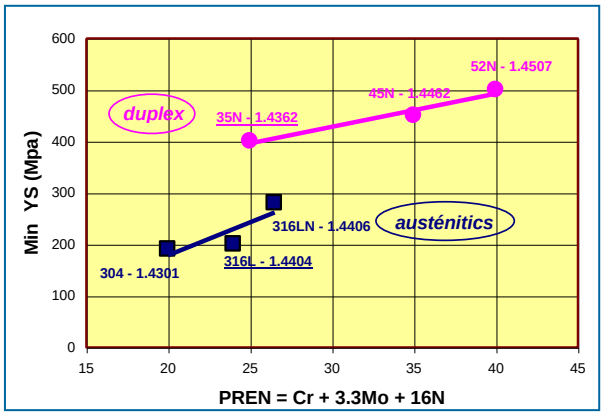
General presentation

Mechanical properties in bars (YS & UTS) are

- better than those of 316L and also those of 316LN,
- better Corrosion Resistance than that of 316L



Classification

Duplex stainless steel.

Designation

Material No

Europe	USA	
EN	**ASTM**	**ISO 15510**
1.4362 X2CrNiN23-4	S32304	4362-323-04-I

UGI® 4362 is supplied according to EN 10088-3 and to ASTM A276

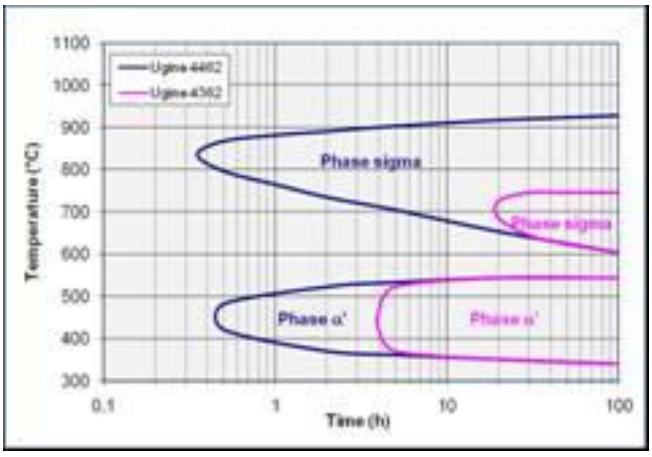
Other material name

Common name	France	Germany	Sweden
	AFNOR	**DIN**	**S.S**
2304	Z3CN23-04 Az	1.4362	2327

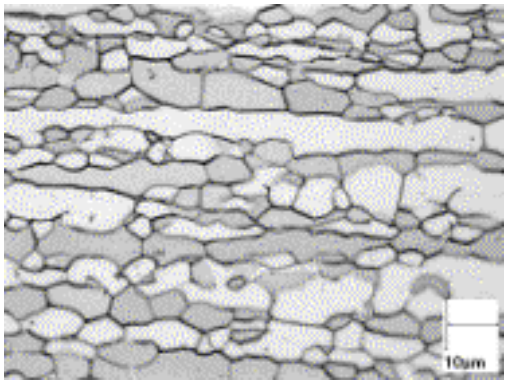
Microstructure

The chemical composition is balanced to obtain 40-60% ferrite after annealing between 950 and 1050°C followed by a fast cooling.

The sensitivity to precipitation of (σ, χ) intermetallic phases (which cause embrittlement) is much lower than that of Duplex 4462. Typically, σ phase precipitation requires over 10 hours at 800°C, a situation seldom encountered in processing operations.



Precipitation of α' phase can occur under long term holding in the 350°C - 550°C temperature range, leading to embrittlement. Thus, the maximum service temperature should not exceed 300°C.



Microstructure of UGI® 4362 (grey: ferrite; white: austenite)

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Mechanical properties

UGI® 4362 exhibits attractive mechanical properties: YS and UTS values are thus twice as high for bars as those of a type 1.4404 or 316L grade.

		Rm (Mpa)	$Rp_{0,2}$ (Mpa)	A%	Z%
Turned Bars		630 / 780	430 / 530	40 / 50	70/80
Drawn Bars (according to the amount of cold work)		800 / 1000	600 / 750	20 / 30	65 / 75
Wire Rod		660 / 780 (840 max)	380 / 500	40 / 52	
Drawn Wire* ex :	Ø2 mm cold worked	1933	1386	2	48
	Ø2 mm annealed	880	545	28	80

* Values given for indication only. Refer to work hardening curves in the wire drawing chapter.

	at -46°C	at 20°C
V Notch Toughness	≥ 7,5 daJ/cm²	≥ 9,0 daJ/cm²

Physical properties

Temperature	Density	Elastic modulus	Thermal conductivity	Expansion coefficient	Electrical resistivity
(°C)	(kg/dm^3)	(N/mm^2)	(W/m.°C)	(./°C)	(µΩ.mm)
20	7,8	200 000	16,7	-	800
Between 20 and 300	-	-	-	$14,0 \times 10^{-6}$	-

Corrosion resistance

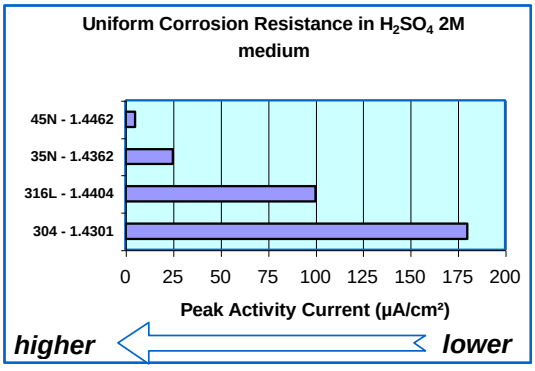
Generalized corrosion

The UGI® 4362 grade can replace 316L (4404) in most known applications; in particular:

- construction market for exposure in urban or maritime atmosphere
- pulp and paper industry
- chemical industry , for sulfuric acid production for instance
- …

This is illustrated by the corrosion diagrams in H_2SO_4 an in NaCl media

Note: for use in boiling organic acids, please inquire



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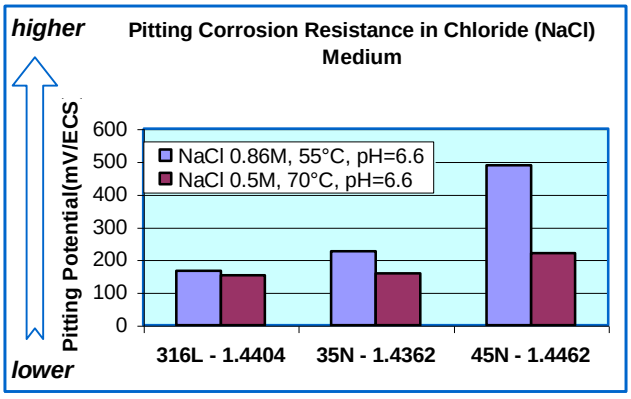
Localized corrosion

– Pitting corrosion

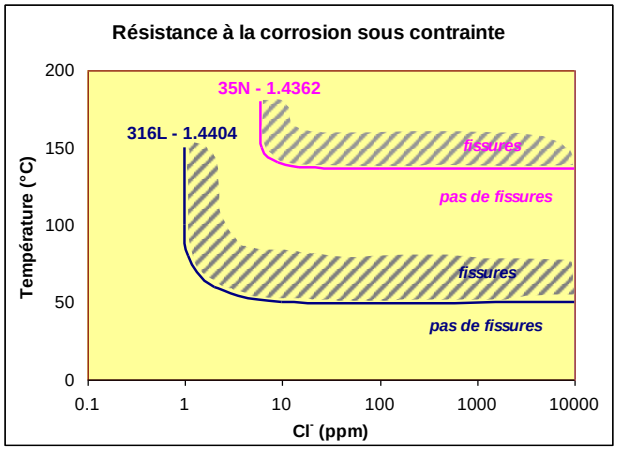
The UGI® 4362 grade exhibits a bettre pitting corrosion resistance in NaCl medium than 316L (4404)



Stress corrosion cracking (SCC)

Stress Corrosion Cracking tests in a Chloride Medium (8 ppm O_2) at pH=7 , under a stress level exceeding the elastic limit and for more than 1000 hours have shown that UGI® 4362 performs better than 316L (4404).

UGI® 4362 may be used in this type of solution up to 130°C without risk of SCC. By contrast, for 316L (4404), the temperature should not exceed 50°C.



Hot transformation

Forging

UGI® 4362 grade can be readily forged between 1250 and 950°C, even though it is not as easy as for the usual austenitic grades (304 & 316). The hot workability depends on the ferrite content, which in turn increases with temperature: high temperatures will bring the best forging ability.

High temperature flow stresses of duplex grades are lower than that of austenitic grades. Thus, less mechanical power is required to forge a duplex grade. Precautions should be taken to avoid creep deformation.

After hot forming, a fast cooling (water or air) is necessary to prevent precipitation of sigma phase. Solution annealing is then optional. If forging finishes around 900°C, mechanical properties (YS and UTS) will increase due to strain-hardening.

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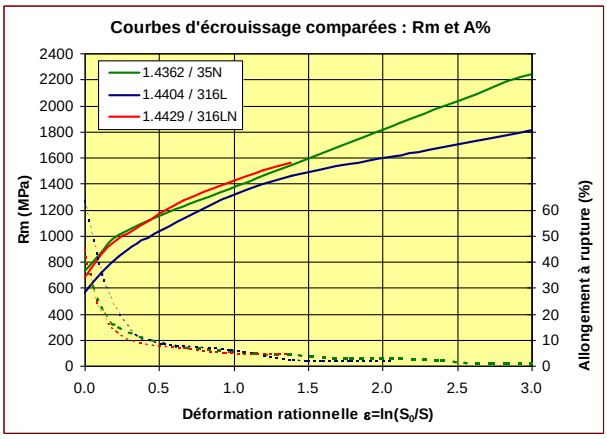
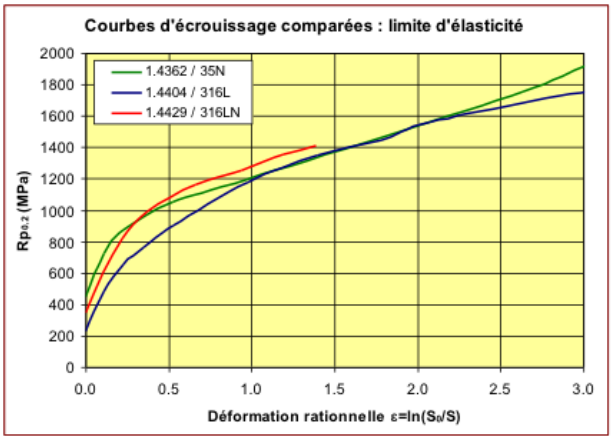
Cold transformation
Wire drawing – Profiling

The UGI® 4362 is suitable for wire drawing and can be work hardened more than a 316L (1.4404), in comparable fashion to a 302 (1.4310).

The work hardened UGI® 4362 can also be used for spring wire.

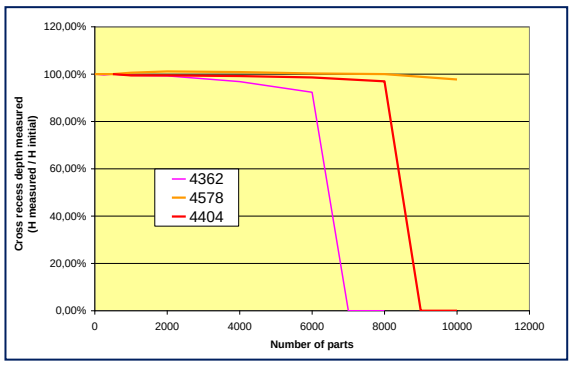


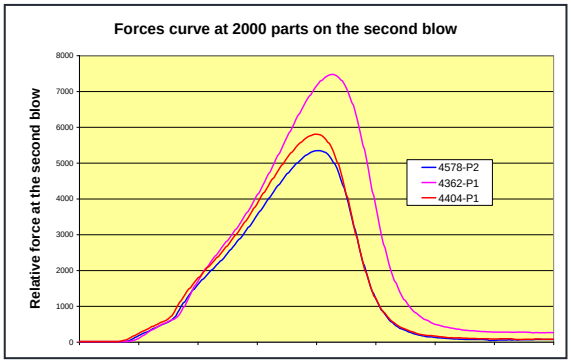


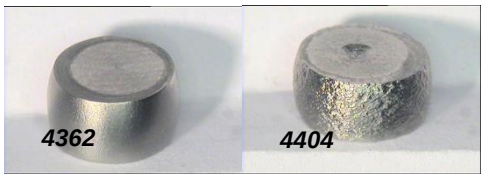
Cold heading

UGI® 4362 can be used for cold heading to replace 4404 and 4578, if a certain number of precautions are taken. It allows the manufacture of both ordinary and technical parts if the heading is not too severe.

When a cruciform recess-type reference part was manufactured at the R&D Center, measurement of the heading







force showed an additional force of 20% for the duplex in comparison with the 1.4578 and the 1.4404

Stamp wear will also be more significant if 4362 is used, in comparison with 1.4578 and 1.4404.

When manufacturing a cross-head screw, without lubrication (acceleration of the test), the stamp broke after 6000 parts with the 4362, compared with 9000 parts for the 1.4404 and over 10,000 with the 1.4578.

After cold heading, with UGI® 4362 the free edge surface is smooth, contrary to 1.4578 and 1.4404, as shown by simple crushing between two piles.

The corrosion resistance of the cold headed parts is identical to that of parts manufactured with 1.4404 and 1.4578, to the extent that no severe heading defect was generated. If the

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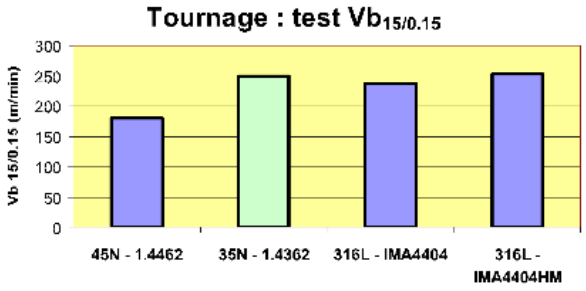
manufacture of the parts is performed with care and the parts are correctly cleaned with rotation (trommel, etc.), then corrosion resistance can be significantly higher than that of the 1.4578

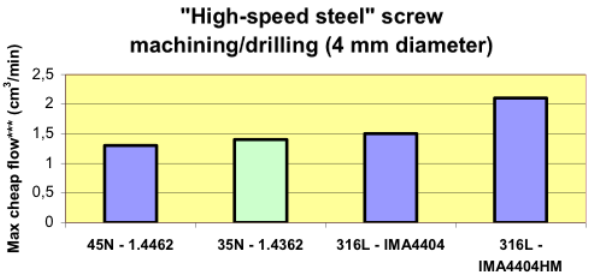
Machinability

Turning

In turning operations ($Vb_{15/0.15}$ test with the Kennametal KC9225 tool), the UGI® 4362 grade appears better than EN 4462 and equivalent to UGIMA® 4404.

Tool/material tests are to be performed to complement these results



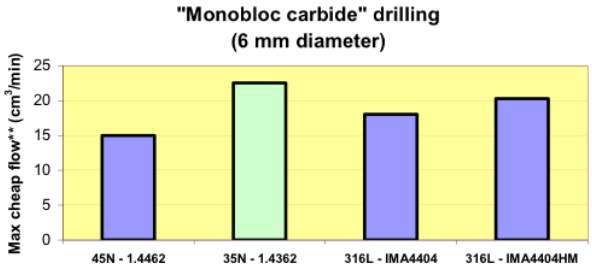


Drilling

– **Drilling (Ø4 mm high-speed steel drill):**
for ∅4 mm drilling, chip containment creates the same problem with respect to chip removal as that observed with Duplex 4462, due to poor chip breakability.

* Max. chip flow for 1140 holes 16 mm deep using the same drill

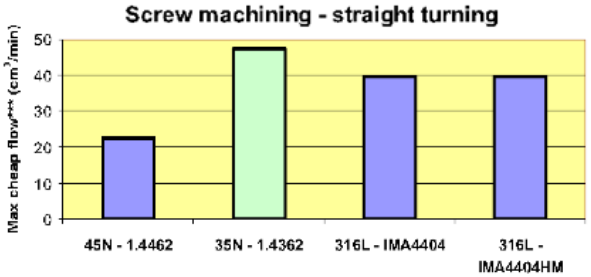
– **Drilling (Ø6 mm carbide + TiN drill):**
For ∅6 mm drilling, the poor chip breakability of 4362 does not appear to create any difficulties in terms of reducing the optimum working area or the useful life of the tools, as the 4362 grade behaves better than UGIMA® 4404 with respect to these two parameters, irrespective of whether or not the HM version is used.
Caution: the surface condition of the drilled holes may be of inferior quality, due to poor chip breakability.



** Max. chip flow for 516 holes 24 mm deep using the same drill.

Screw machining

Straight turning: confirms the very good behaviour of 4362 in turning operations, which is better than that of UGIMA® 4404 in this case.



Drilling with a Ø4 mm high-speed steel drill: confirms the difficulty of chip removal due to the poor chip breakability of 4362 in the absence of central cooling compared with UGIMA® 4404 HM

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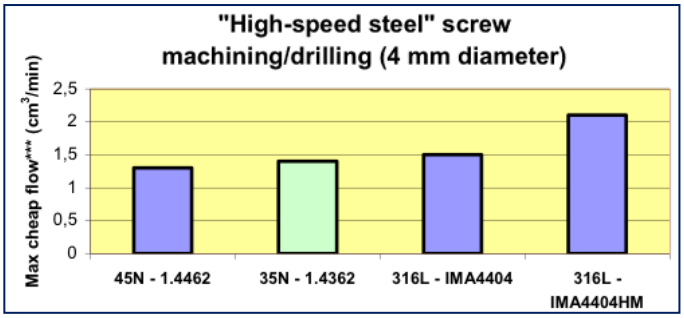
Cross-cutting

Intermediate behaviour between UGIMA® 4404 HM and 4462 (see the table below).

*** Max chip flow for tool behaviour for 700 screw-machined components.



Optimum cross-cutting conditions for ∅10 mm bars for cross-cutting 700 components with the same tool.

	45N – 1.4462 (1)		**35N – 1.4362 (1)**	
Test	Speed (m/min)	Feed (mm/rev)	Speed (m/min)	Feed (mm/rev)
Cross-cutting	60	0.04 / 0.015	100	0.05 / 0.025
Useful life	*1794*		*1377*	
	316L – UGIMA® 4404 (2)		316L – UGIMA® 4404 HM (2)	
Test	Speed (m/min)	Feed (mm/rev)	Speed (m/min)	Feed (mm/rev)
Cross-cutting	140	0.05 / 0.015	140	0.07 / 0.035
Useful life	*939*		*1104*	

(1) Sandvik 2135 (N151.2-200-SE); (2) Iscar IC328 GFN 2J

Welding

UGI® 4362 may be welded by friction, by electrical resistance, by electric arc with or without filler metal TIG, MIG, electrode, plasma, under flux…), by laser beam, by electron beam…

The low Mo content of the grade, precludes sigma phase formation in welding operations, unlike other duplex stainless steels which require precautions. Welding is therefore straightforward, and not much more complex than that of austenitic grades such as 304L (4307) or 316L (4404). Duplex is even better as far as hot-cracking is concerned.

However, in order to optimize the impact properties of the welds, the welding conditions should maximize the welding energy in order to limit the amount of ferrite in the molten zone and in the heat affected zone.

Various filler metal grades may be used to weld UGI® 4362, depending on the mechanical properties and the corrosion resistance required in the welds. The main ones are:

– UGIWELD™ 45N / ER 2209 / 22.9.3NL
– UGIWELD™ 309LM /ER 309LSi / 23.12LSi

Preheating of the parts before welding is not necessary. No post weld heat treatment is required and should be carried out, with the possible exception of a complete solution anneal, if required.

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Available products

Product	Form	Finishing	Tolerance	Size
Bars		Hot Rolled, desalled	13	
Bars		Cold drawing, turned, ground, Bright	6 to 11	
Wire Rod	round			5.5 ≤ ø ≥ 32 mm
Drawn wire				

Other contact us.

Applications

Generally speaking, wherever 316 & 316L (4401 &4404) are used.

- Energy & Process industries
- Construction
- Food processing

Limitations of use:

- Cryogenic Applications (low toughness at cryogenic temperatures)
- Service temperatures exceeding 300°C

In case of doubt, please enquire