

Technical Data Sheet

技术数据表

UGIMA®-X 4404

Chemical analysis (%)

C	Si	Mn	Ni	Cr	Cu	Mo	P	S
≤ 0.03	≤ 0.75	0.5 – 1.5	8.0 – 9.5	18.0 – 19.0	≤ 0.75	≤ 0.5	≤ 0.10	≤ 0.040

22-03-2019 – REV 00

General presentation

概述

UGIMA®-X 4404 is a stainless steel of highly improved machinability manufactured only by Ugitech.

UGIMA®-X 4404 是由 Ugitech 独家生产的高性能机加工不锈钢。

Its properties are identical to those of other 1.4404s except for its machinability, which is even better than that of UGIMA® 4404 and UGIMA® 4404 HM, the 1.4404 grades from Ugitech with already improved machinability:

UGIMA®-X 4404 与其他 1.4404 相比，尽管具有更加优异的切削性能，其他性能仍与 1.4404 保持一致。虽然 Ugitech 1.4404 的机加工性能已经经过提升，但 UGIMA®-X 4404 的机加工性能比 UGIMA® 4404 和 UGIMA® 4404 HM 更加优异。

- UGIMA®-X 4404 is a stainless steel resulting from an improved production and control process in the inclusive UGIMA population developed by Ugitech.
- UGIMA®-X 4404 是 Ugitech 通过改进生产和控制工艺开发的 UGIMA®系列中的不锈钢产品。

Designation

名称

Material No.

材料牌号

Europe – EN 欧洲 – EN		USA – UNS 美国 – UNS	Japan – JIS 日本 – JIS	World – ISO 国际 – ISO
1.4401	X5CrNiMo17-12-2	S31600	SUS316	4401-316-00-I X5CrNiMo17-12-2
1.4404	X2CrNiMo17-12-2	S31603	SUS316L	4404-316-03-I X2CrNiMo17-12-2
Other material name 其他名称				
USA (AISI) 美国(AISI)	France (AFNOR) 法国(AFNOR)	Germany (DIN) 德国(DIN)	UK (BS) 英国(BS)	Sweden (S.S) 瑞典(SS)
316	Z7CND 17-11-02	1.4401	316S31	2347
316L	Z3CND 17-11-02	1.4404	316S11	2348

– UGIMA®-X 4404 represents a technological advance which has advantages whatever the machining conditions, machinery or tools used; its machinability is optimal at high cutting conditions.

– 无论在任何加工条件下，使用任何机械装置或切割工具都能展现 UGIMA®-X 4404 优越的技术属性。在高速切割条件下能达到最理想的机加工性能。

– Compared to the UGIMA® 4404, the grade already improved in terms of machinability, increases of 15% and 20% have been achieved in turning and drilling respectively, and compared to UGIMA® 4404 HM turning is increased by 7% and drilling increased by 12 %.

– UGIMA®-X 4404 机加工性能与改良后的 UGIMA® 4404 相比，旋转和钻孔的效率分别提高 15%和20%。与 UGIMA® 4404 HM 相比，旋转和钻孔的效率分别提高 7%和 12%。

Classification

分类

Improved Machinability Austenitic Stainless Steel with Molybdenum.

提高机加工性能的奥氏体含钼不锈钢



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Mechanical properties

机械性能

Tensile data

抗拉数据

	Yield stress 屈服强度	Tensile strength 抗拉强度	Elongation 拉伸率	Reduction of Area 断面收缩率
	Rp0,2% (MPa)	Rm (MPa)	A (%)	Z (%)
Solution annealed 固溶退火	≥ 220	500 – 600	≥ 45	≥ 70
Work-hardened by drawing 拉拔硬化处理	320 – 660	560 – 800	≥ 32	≥ 60

Limit values for information only; approximate ranges allowing for the different cold drawing rates it is possible to apply (cold drawing rate ↑ = hardness and strength ↑)

数据信息仅供参考。不同的冷压率允许有近似范围（冷压率↑=硬度和强度↑）。

Physical properties:

物理性质

Temperature 温度	Density 密度	Elastic modulus 弹性模量	Thermal conductivity 热传导性	Expansion coefficient 膨胀系数 From 20 to 500°C 20°C-500°C	Electrical resistivity 电阻率	Specific heat 热容
(°C)	(kg/dm³)	(GPa)	(W/m.K)	(K ⁻¹)	(μΩ.mm)	(J/kg.K)
20	7.90	196	15.0	-	750	500
200	-	-	-	16.5 x10 ⁻⁶	-	-

(Indicative values 参考值)

Magnetic properties:

磁性

Like most austenitic stainless steels, UGIMA®-X 4404 is almost non-magnetic after a solution annealed heat treatment. However, after cold drawing, mild ferromagnetic behavior may be observed due to the destabilization of the austenite.

与绝大多数奥氏体不锈钢一样，UGIMA®-X 4404 经固溶退火处理后基本没有磁性。但在冷压后，由于奥氏体的不稳定性，可以观察到轻微的铁磁现象。



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Corrosion resistance

抗腐蚀性

UGIMA®-X 4404 has the same corrosion resistance as UGIMA® 4404. It therefore has excellent corrosion resistance in natural atmospheres: watercourses, rural and urban atmospheres, industrial atmospheres, even in the presence of moderate concentrations of chlorides and acids, in food and farm-produce environments and in numerous acid (sulfuric, phosphoric and organic) and chlorinated atmospheres, under certain temperature and concentration conditions.

UGIMA®-X 4404 与 UGIMA® 4404 拥有相同的抗腐蚀性。因此，它在水道、农村和城市、工业等自然环境中具有优异的耐腐蚀性。一定温度和浓度下，即使在中等浓度的氯化物和酸的环境中、在食品和农产品环境中、以及在各种酸（硫酸、磷酸和有酸）和含氯环境中也具有有良好的耐腐蚀性。

Environment	环境	Behavior	表现
Nitric acid	硝酸	Good	良好
Phosphoric acid	磷酸	Moderate	一般
Sulfuric acid	硫酸	Moderate	一般
Acetic acid	乙酸	Good	良好
Sodium	碳酸钠	Moderate	一般
NaCl (Saline mist)	氯化钠	Good	良好
Humidity	潮湿	Excellent	优异
Petrol	汽油	Moderate	一般
Seawater	海水	Moderate	一般

UGIMA®-X 4404 effectively resists intergranular corrosion even after welding and passes the standardized tests:

Ugima®-X 4404 即使在焊接后也同样能有效抵抗晶间腐蚀，并通过标准化测试：

- AFNOR NFA05-159,
- ASTM A262 – 75 PRACTICE E,
- DIN 50914,

And, on request, special tests.

及其他根据要求所做的特殊测试。

UGIMA®-X 4404 can be used in marine environments and in highly oxidizing chemical atmospheres.

The use of UGIMA®-X 4404 is compatible with all fluids, lubricants, oils and greases applied in industry and machining. Optimum corrosion resistance is achieved on a surface free from residual machining oils or foreign particles (iron, for example).

UGIMA®-X 4404 可用于海洋环境和高氧化性环境中。机械加工领域使用的所有的润滑液、润滑剂、润滑油和润滑脂都适合用于对 UGIMA®-X 4404 的加工。在没有残留加工油或杂质颗粒（例如，铁屑）的表面上可获得最佳的耐腐蚀性。

The pickling of UGIMA®-X 4404 is comparable to that of a standard 1.4404 such as UGI® 4404.

UGIMA®-X 4404 的酸洗标准与 1.4404（如，UGI® 4404）的酸洗标准类似。

The decontamination of steels is not recommended because of the complexity and cost of this operation; however, if this is necessary, the recommended decontamination / passivation treatment is as follows:

由于操作的复杂性和出于对成本的考虑，不建议对钢材进行去污处理；但是，如果有必要，建议去污/钝化处理如下：

- 1 volume nitric acid 52% (36° Baumé)
- 52% (36° Baumé)的硝酸
- 1 volume water
- 与硝酸溶液等量的水
- at room temperature
- 室温
- short duration
- 短时间处理
- finish with thorough washing
- 处理后彻底清洗



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The corrosion resistance of a stainless steel depends on a number of factors, both in terms of the composition of the aggressive atmosphere (chloride concentration, presence or absence of oxidants, temperature, pH, whether or not there is agitation, etc.) and in terms of the material (surfaces free from ferrous particles, surface condition such as cold drawing, polishing, etc.). Precautionary measures must also be taken for certain tests, e.g. for saline mist (ISO 9227): for example, the use of marking labels placed on the sample must be avoided as these could cause corrosion run-outs and minimize the duration of resistance in the test.

不锈钢的耐腐蚀性取决于多种因素。既取决于腐蚀性环境中的成分（氯化物浓度、是否存在氧化剂、温度、pH、搅拌与否等），也取决于材料因素（表面无有色金属颗粒，成品表面的冷拉、抛光处理等）。对于某些试验，如盐雾试验（ISO 9227），需要注意一些事项。例如，不应在样品上使用标记物。这将导致腐蚀失效的或缩短样品的抗腐蚀试验时间。

Hot transformation – Forging

相变 – 锻造

The forging of UGIMA®-X 4404 pose no particular problems:

UGIMA®-X 4404 的锻造不存在任何特殊问题：

- Heating without special precautions up to 1150°-1180°C.
- 无需特别注意事项，加热至 1150°-1180°C。
- Forging between 1180°C and 950°C (the best results being obtained between 1100 and 1180°C).
- 锻造温度在 1180°C 至 950°C 之间（在 1100°C 至 1180°C 之间，可获得最佳锻造效果。）
- Cooling in air or water, if no deformation is feared. Priority will be given to cooling in water for high charges (avoid cooling stacked forgings in air).
- 如果不担心变形可进行空冷或水冷。优先考虑进行水冷（避免空冷时锻件被堆叠在一起）。

Heat treatment

热处理

The heat treatment of UGIMA®-X 4404 consists of quenching the metal in water or air after keeping it for an extended period (at least half an hour) at a high temperature of between 1000 and 1100°C. This solution annealing heat treatment enables all traces of cold drawing to be removed whilst providing the steel with its lowest level of mechanical properties.

UGIMA®-X 4404 的热处理：在 1000°C 至 1100°C 的高温下保持至少半小时后，将金属在水中或空气中冷淬。这种固溶退火处理可去除所有冷拉痕迹，同时保持钢的机械性能达到最低水平。

Machinability

机加工性能

Due to specific optimization of the entire oxide population in the grade, UGIMA®-X 4404 guarantees exceptional machinability performances for a 1.4404. Such performances are provided especially in very high or severe cutting conditions.

Its performance is based on very good chip breaking, increased tool service lives and very good surface finish after machining.

由于对氧化物进行了特殊优化，UGIMA®-X 4404 保证了 1.4404 优越的机加工性能。尤其在严苛的切割条件下，更能凸显优势。良好的断屑性能，高质量的加工表面以及刀具使用寿命的延长，均体现了材料卓越的机加工性能。

To obtain the maximum benefit from the potential of this grade, in terms of parts and working environment, contact our Technical Support Department.

为最大程度地获得本材料在机加工性能上带来的优势，请联系我们的技术支持部门对部件与工作环境进行咨询。



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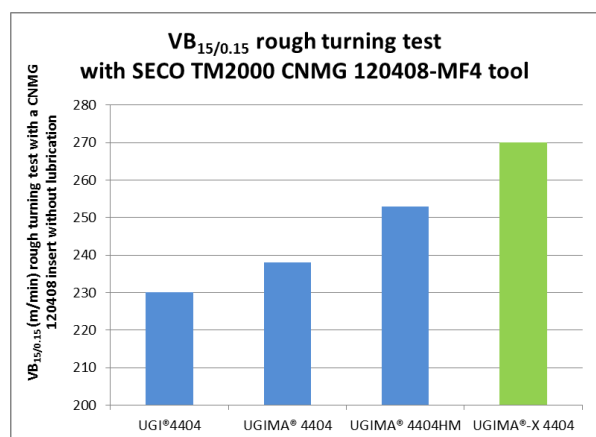
Turning

车削

VB_{15/0.15}

In terms of tool insert wear (VB_{15/0.15} tests, representative of the potential rough turning productivity), the accessible cutting conditions of UGIMA®-X 4404 increase by nearly 15% compared with the already improved UGIMA® 4404. The VB_{15/0.15} tests obtained with SECO TM2000 CNMG 120408-MF4 inserts are shown in the chart below.

在刀具磨损方面（VB_{15/0.15} 测试：代表潜在粗车生产能力），与 UGIMA® 4404（UGIMA® 4404 的工业机加工性能分布已属优良）相比，UGIMA®-X 4404 的切削效率增加了近 15%。以下图表显示 SECO TM2000 CNMG 120408-MF4 镶块/刀刃的 VB_{15/0.15} 测试结果。



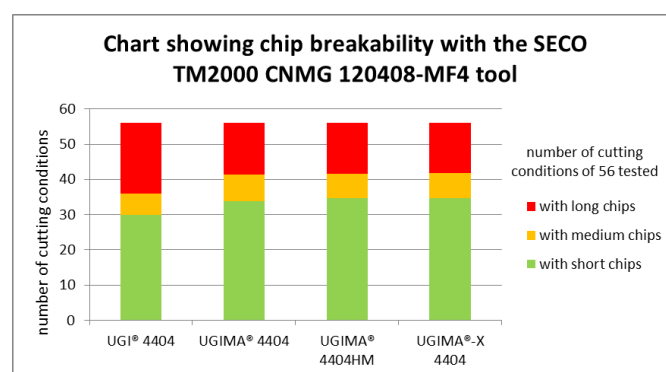
Chip Breaking Zones (CBZ):

断屑区(CBZ)

In terms of chip breakability (CBZ tests, representative of the ability of the metal to limit machine downtime due to chips becoming entangled around the tools), the number of short chip cutting conditions for UGIMA®-X 4404 is slightly increased compared to those obtained with the already improved UGIMA®4404 and UGIMA® 4404HM. This is shown in the following charts, which indicate the number of machining

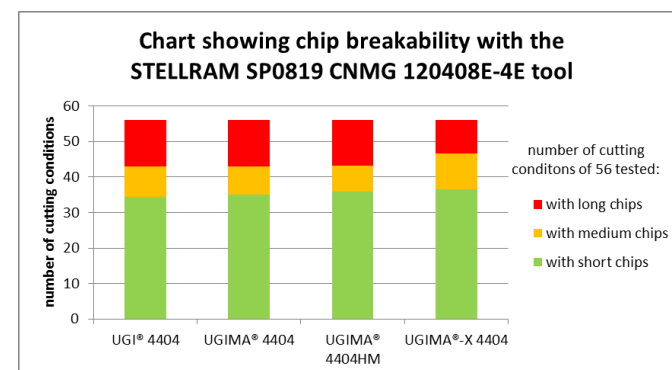
conditions producing short, medium and long chips (among those tested*) for two reference turning inserts and for each stainless steel grade tested.

在断屑性能方面（CBZ 测试：代表减少因金属断屑缠绕刀具导致机器停机时间的能力）方面，UGIMA®-X 4404 的短条断屑数量比已改良过的 UGIMA® 4404 和 UGIMA® 4404HM 还略有增量



，以下图表可表明这一特点。该图表显示了两种车削刀具和三种不锈钢钢种在切削测试中所产生的短条断屑、中长条断屑和长条断屑的比例。

* the conditions tested are as follows: at a constant cutting speed (200 m/min), the feed rate "f" is varied from 0.1 mm to 0.4 mm/rev, in increments of 0.05 mm/rev, and the cutting depth "a_p" is varied from 0.5 mm to 4 mm, in increments of 0.5 mm; fifty-six conditions were tested using this method.
*测试条件如下：恒定切削速度（200 米/分钟），进给量 "f" 在 0.1 毫米/转至 0.4 毫米/转之间变化，增量为以 0.05 毫米/转的增量进行不同的进给量测试。切削深度"a_p"在 0.5 毫米至 4 毫米之间变化，增量为以 0.5 毫米/转的增量进行不同的切削深度测试。使用此方法共测试了 56 个不同的切削状态。



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Drilling

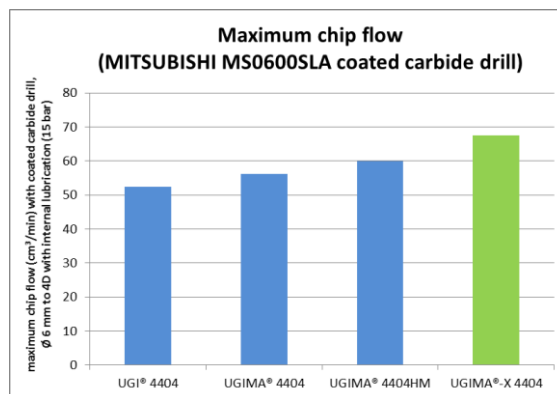
钻孔

To compare UGIMA®-X 4404 to the other 1.4404 grades in drilling, tests were carried out using coated carbide drills of $\varnothing 6$ mm, with central coolant (soluble oil at 15 bars). Tests were carried out at 4D (24mm depth) for different drilling conditions in order to find the domain (in terms of cutting speed and feed rates) in which 550 holes could be drilled with a drill without breaking it. The wider the domain, the better the grade. Maximum chip flow rates were consequently defined in line with the better productivity in obtaining the 550 holes with one drill. The higher this flow rate, the better the grade.

为了比较 UGIMA®-X 4404 与其他 1.4404 钢种在钻孔方面的表现，使用直径 6mm 的硬质合金涂层钻头和中央冷却液（可溶性切削油，压力 15bar）进行试验。在 4D（24mm 深）处进行了不同钻孔条件的试验，以找出钻头钻 550 个孔而钻头不会断裂的区域（根据切削速度和进给速度）。该区域越广，代表钢种的加工性能越好。以一个钻头能钻 550 个孔为例，高生产率与最大切屑流速对应。因此，切屑流速越高，钢种的加工性能越好。

UGIMA®-X 4404 has a wider domain than that of UGI® 4404, even the already highly improved UGIMA® 4404HM; Because of this, the maximum chip flow rate of UGIMA®-X 4404 is improved by 12%, 20% and 30% compared to UGIMA® 4404 HM, UGIMA® 4404 and UGI® 4404 respectively, as shown in the following chart.

UGIMA®-X 4404 比 UGI® 4404 的连续钻孔区域更广，甚至比改良过的 UGIMA® 4404HM 表现更好。UGIMA®-X 4404 的最大切屑流速比 UGIMA® 4404 HM，UGIMA® 4404 和 UGI® 4404 分别提高了 12%，20% 和 30%。如下图表所示。



Welding

焊接

UGIMA®-X 4404 can be welded without undue difficulty, with or without welding filler wire. If a welding filler wire is required, use grades E316L (coated electrodes), ER316L (GTAW), or ER316LSi (GMAW).

无论是否使用焊接填丝都不会影响 UGIMA®-X 4404 的焊接。如果要求使用焊接填充丝的话，可以选择 E316L（焊条焊接）、ER316L（钨极惰性气体保护焊）或 ER304LSi（熔化极气体保护焊）。

In GMAW or GTAW welding, to avoid any risks of hot cracking, welding heat input should be limited (to avoid the sulfur segregation responsible for the hot cracking phenomena occurring during weld pool cooling). However, for laser welding, welding heat input must be maximized (to avoid too rapid cooling which brings about hot cracking of the welds by austenitic solidification).

使用熔化极气体保护焊或钨极惰性气体保护焊接时，为避免热裂纹的产生，应控制焊接热能的输入量（以避免在熔池冷却时发生硫偏析，进而产生热裂纹现象）。然而，对于激光焊接，应最大限度的增加焊接热能的输入量（以防止过快的冷却速度使奥氏体凝固，导致焊接热裂纹的产生）。



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No heat treatment is required after welding.

焊接后无需热处理。

Available products

产品信息

Product 产品	Shape 横截面形状	Surface finish 成品表面	Tolerance 公差	Dimension 尺寸
Bar 棒材	Round 圆形	Rolled and descaled 轧制和剥皮	12 – 13	22 – 130 mm
	Round 圆形	Turned and polished 车削和抛光	9 – 11	22 – 130 mm
	Round 圆形	Drawn 拉拔	8 – 9	1.8 – 55 mm
	Round 圆形	Ground 磨光	7 – 9	1.8 – 80 mm
	Hexagonal 六角形	Drawn 拉拔	11	3 – 55 mm
Drawn wire 拉拔线材	Round 圆形	Mat 哑光		1 – 14 mm

Other formats: contact us
如需其他信息，请联系我们。

Applications

应用

- General component production
— 组件生产
- Chemical industry
— 化工
- Oil, petrochemical and nuclear industries
— 石油、石油化工和核工业
- Food-processing and agricultural industries
— 食品加工和农业
- Decorating and household equipment
— 装饰和家用设备
- Building and construction, transport
— 建筑、施工和运输
- Electronic equipment
— 电器



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