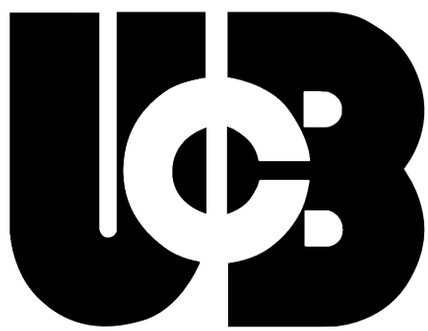

Unibar

Technical Documentation

Unibar. Continuous Cast Iron Bar produced by United Cast Bar Limited

Spital Lane, Chesterfield, Derbyshire.

S41 0HS. (United Kingdom)

☎ +44 (0) 1246 20 11 94 +44 (0) 1246 54 04 34

www.unitedcastbar.com

e-mail: sales@unitedcastbar.com

UNIBAR: ADDITIONAL INFORMATION

7.0

UNIBAR: ADDITIONAL INFORMATION

GENERAL CHARACTERISTICS

CHARACTERISTIC	Unit	Unibar-200	Unibar-250	Unibar-300	Unibar-350	Unibar-450-15	Unibar-500-7	Unibar-600-3	Unibar-750-2
Resistance to Shearing	N/mm2	150-200	200-300	300-350	350-400	300-400	400-500	450-550	550-650
Torsion Resistance	N/mm2	150-200	200-300	300-350	350-400	300-400	400-500	450-550	550-650
Poisson Coefficient	-----	0.26	0.26	0.26	0.26	0.275	0.275	0.275	0.275
Resistance to Compression	N/mm2	500-700	700-850	850-950	900-1000	700	800	870	1000
*Elasticity Modulus E	GN/mm2	-----	-----	-----	-----	169	169	175	176
**Elasticity Modulus E	KN/mm2	75-110	100-120	110-130	120-140	-----	-----	-----	-----
Limit of Elasticity at 0.1%Conventional ***	N/mm2	100-180	160-220	190-250	220-280	-----	-----	-----	-----
Elongation ****	%	0.2/0.8	0.2/0.8	0.2/0.8	0.2/0.8	12-18	7-14	3-10	1-5
Resistance to Buckling	N/mm2	250	330	380	480	-----	-----	-----	-----
Limit of Fatigue Without Notch (Ø10.6)	N/mm2	-----	-----	-----	-----	180-200	200-220	220-250	250-280
Ratio of Fatigue Without Notch	Limit/UTS	-----	-----	-----	-----	0.5	0.45	0.4	0.4
Limit of Fatigue *****	N/mm2	-----	-----	-----	-----	110-120	120-140	140-155	155-170
With Notch (Ø10.6) Thermal Conductivity at 300ºC	W/(Kº.m)	50	45	45	43	36.2	35.2	32.5	31
Thermal Capacity 20º-500ºC	J/(kg.Kº)	460-535	460-535	460-535	460-535	515	515	515	515
Coefficient of Lineal Dilation 20º-400ºC	μ.m/(m.K)	11.7-13	11.7-13	11.7-13	11.7-13	11.7-13	12.5	12.5	12.5
Density	kgs./dm3	7.1	7.2	7.25	7.3	7.1	7.1	7.2	7.2
Loss through hysteresis (B=1T)	J/m3	2500-3000	2500-3000	2500-3000	2500-3000	600	1000-2000	2000-2500	2700
Resistivity	$\mu\Omega$.m	0.75-0.8	0.7-0.75	0.7	0.7	0.5	0.51	0.54	0.54
Permeability	μH/m	220-330	220-330	220-330	220-330	2136	1596	866	500

Note: The data regarding the UNIBAR-200 to UNIBAR-350 flake cast bar refers to a RD30 separately cast bar.

The data presented is approximate and provided for information only. It is based on the technical bibliography on the subject.

Any requirement for minimums/maximums on top of these parameters must be discussed in advance.

* For stress and compression in spheroidal cast iron.

** Traditional value. There is no elastic or plastic period defined in the breaking of the flake graphite casting.

*** Actual value of elastic limit (0.2%) for spheroidal graphite casting in tables of Unibar standards.

**** Elongation <1% in flake graphite casting. Value of Elongation of spheroidal graphite casting in tables of Unibar standards

***** "V" notch with 45º radius -0.25mm.

COMPARATIVE TABLE OF UNIBAR BEHAVIOUR

From *Zero to *****Excellent

Characteristic	Unibar-200	Unibar-250	Unibar-300	Unibar-350	Unibar-200-P	Unibar-200-F	Unibar-400-15	Unibar-500-7	Unibar-600-3	Unibar-750-2	ADI	Unibar NR-F	Unibar NR-S
Structure	F	P-F	P	P	F-P	F	F	F-P	P-F	P	B	A	A
Fatigue Strength	**	**	***	***	**	**	***	***	****	****	*****	**	***
Resistance to Corrosion	**	**	**	**	***	***	***	**	**	**	****	*****	*****
Machinability	*****	****	***	***	***	****	****	***	**	**	**	***	***
Dampening capacity	*****	****	****	****	****	*****	***	***	***	***	***	****	***
Resistance to Wear	**	**	***	****	**	**	**	**	***	***	******	***	*****
Suitability for Hardening	*	**	***	****	*	*	*	**	***	***	*****	*	*
AustemperedDuctility									**	**	*****		
Weldable	*	*	*	*	*	*	*****	****	***	***	***	*	****
Other Surface hardenings	*	*	*	*	*	*	**	**	**	**	**	*	***
Thermal Conductivity	**	**	***	****	**	**	**	**	***	***	****		
Surface Finish	*****	****	***	***	****	*****	****	***	**	**	**	***	**
Forgeability	**	***	***	****	***	***	****	****	****	****	*****	**	****
Possible Ferritising Annealment	*	*	*	*	*	*	*	*	*	*	*	*	*
Magnetic	-----	Yes	Yes	Yes	Yes	-----	-----	Yes	Yes	Yes	-----	-----	
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No

Structure

P Perlitic P-F Perlitic-Ferritic A Austenitic F Ferritic F-P Ferritic-Perlitic B Bainitic

REFERENCE TO ASSOCIATED STANDARDS

Country	Standard	Unibar-200	Unibar-250	Unibar-300	Standard	Unibar-450-15	Unibar-500-7	Unibar-600-3
Australia 1986	AS1830	T-200	T-250	T-300	AS 1831	400-12	500-7	600-3
Austria 1983	M3191	GG-200	GG-250	GG-300	M 3193	GGG-400	GGG-500	GGG-600
Belgium 1970	NBN 830-01	FGG 20	FGG 25	FGG 30	NBN830-02	FNG42-12	FNG50-7	FNG60-2
Great Britain 1977	BS 1452	Gr.180/200	Gr.260	Gr.300	BS 2789	400/12	500/7	600/3
Denmark 1969	DS 11301	GG 20	GG 25	GG 30	DS 11303	0715-0716	0727	0707
Finland	SFS 4855	GRS 200	GRS 250	GRS 300	SFS 2113	GRP 400	GRP 500	GRP 600
France 1987	NF A32 -101	FGL 200	FGL 250	FGL 300	NF A32 - 201	FGS400-15	FGS500-7	FGS 600-3
Germany 1985	DIN 1691	GG - 20	GG - 25	GG - 30	DIN 1693	GGG-40	GGG-50	GGG-60
Holland 1966	NEN 6002A	GG 20	GG 25	GG 30	NEN 6002D	GN 42	GN 50	GN 60
Hungary 1981	MSZ 8280	öv 200	öv 250	öv 300	MSZ 8277	Göv 400	Göv 500	Göv 600
I.S.O. 1961	R 185	Gr. 20	Gr. 25	Gr. 30	ISO 1083	Gr.400-12	Gr.-500-7	Gr.-600-3
Italy 1969	UNI 5007	G 20	G 25	G 30	UNI 4544	GS400-12	GS500-7	GS600-3
Japan 1976	JIS. G5501	FC 20	FC 25	FC 30	JIG.G5502	FCD40	FCD50	FCD60
Norway 1963	N S 722	S j G 20	S j G 25	S j G 30	NS 11301	NS 11342	NS 11350	NS 11360
Poland 1986	PNH-83101	ZI 200	ZI 250	ZI 300	PNH-82123	Zs40012	Zs50007	Zs60003
Portugal 1981	NP 1758	FGL-200	FGL-250	FGL 300	NP 1759	FGE 400/12	FGE 500/7	FGE 600/3
Rumania 1982	S T A S 568	FC 200	FC 250	FC 300	S T A S 6071	FGN400-12	FGN500-7	FGN600-3
Spain 1973	U N E 36-111	FG 20	FG 25	FG 30	U N E 36-118	FGE 42-12	FGE 50-7	FGE 60-2
Sweden 1984	MNC 705E	SSOI 20-00	SSOI 25-00	SSOI 30-00	MNC 706E	SS07 17-00	SS07 27-02	SS07 32-03
Switzerland 1961	VSM 10691	FGL 200 GG 20	FGL 250 GG 25	FGL 300 GG 30	VSM 10693	GGG42 FGS42	GGG50 FGS50	GGG60 FGS60
USA 1983	ASTM A48	Class 25	Class 35	Class 40	ASTM A536	65-45-12	70-50-07	80-60-03
USSR	GOST 1412	SC 20	SC 25	SC 30	GOST 7293	Vch40	Vch50	Vch60
Yugoslavia	JuscC. J2020	SL 20	SL 25	SL 30	JuscC. J2022	NL 42	NL50	NL60
Meehanite		GE200	GD250	GB300		SF 420.12	SFP500	SPF600
EN 1561		GJL-200	GJL-250	GJL-300	EN 1563	GJS-400-15	GJS-500-7	GJS-600-3

UNIBAR COLOUR CODES

FLAKE		DUCTILE	
Grade	**Colour**	**Grade**	**Colour**
Unibar- 200	Orange	Unibar-400-15	Yellow
Unibar- 250	(No Colour)	Unibar-500-7 Low hardness	Light Green
Unibar- 300	Red	Unibar-500-7 High hardness	Dark Green
Unibar- 350	Violet	Unibar-600-3	Light Blue
Unibar- G – P	Silver (one end)	Unibar-700-2	Dark Blue
Unibar- G – F	Silver (both ends)	Unibar-NR - S	Red - Yellow
Unibar- NR – F	Black - Yellow		

GLOSSARY AND USEFUL FORMULAS

- **ALLOY. -** Material with metallic properties consisting of two or more elements, at least one of which is a metal.

- **ALLOYING ELEMENTS. -** Chemical elements that constitute an alloy.

- **ANNEALED. -** Heat treatment of metal alloys whose purpose is to soften or eliminate stress. In grey casting there are 2 types of softening annealing: one for eliminating carbides, (temp 850-940ºC,) and another involving ferritisation, (temp-680-740ºC).

- **AUSTEMPERING. -** Heat treatment of iron alloys which consists (after raising the temperature to 850-950ºC for austenising) of cooling at a high temperature 250-450º (in a salt bath) obtaining bainitic structures which give the alloy properties of toughness higher than the martensitic structure produced by normal hardening, while maintaining high strength.

- **AUSTENITE. -** Solid solution of carbon in gamma Fe (approximately 1.8% C maximum), stable only at high temperatures. At low temperatures it is stable only if it contains high %s of elements such as Ni.

- **BAINITE. -** Structural constituent of the casting and the steel. It is obtained from the conversion of austenite at a temperature higher (>Ms) than that of the normal cooling that applies during the hardening process. The process for obtaining bainite is called austempering and consists of isothermic hardening with cooling at 250-400ºC, (in a salt bath).

- **BRINELL, HARDNESS. -** As this is the hardness of the resistance of materials to penetration, the Brinell hardness value (H.B.) is determined by the relationship between an applied load (Kg) on a ball of a certain diameter, and the area of the spherical cap- indentation of the trace (mm). For example, HB 187.5/2.5 indicates that the test is carried out with a ball of 2.5 mm in diameter and load of 187.5 Kg.

- **CARBIDES. -** Compounds of carbon and another metallic element. Normally they are components that give the cast structure hardness and brittleness, although they also confer wear resistance. Iron carbide is the carbide known as cementite.

- **CARBON EQUIVALENT. -** Even though the fundamental element in castings is the % of C, the % of Si and the % of P have an equivalent influence depending on the formula indicated.

$$C.E. = \%C \frac{(\%Si+\%P)}{3}$$

- **CEMENTITE. -** See "Carbides". This is formed when the liquid casting cools in accordance with what is known as the metastable diagram. Normally its presence as free cementite is not desirable because of its hardness and brittleness. However, sometimes it is beneficial in order to give the structure wear resistance.

- **COOLING MODULUS. -** Relationship between the volume and the cooling surface of a certain mass of metal or liquid alloy. In particular, we can point out the cooling modulus of some of the most important geometric figures. Sometimes the inverse relationship S/V is taken, instead of the V/S one taken below as the cooling modulus.

  - Wall of thickness "x" - . . . . . .Modulus =V / S = x / 2
  - Round bar of diameter D=2.R. . . . . .Modulus = V / S = R /2
  - Rectangular Bar of L"(breadth) and "l" (height). Modulus = (L. l) / 2. (L+l)
  - Square bar of "L " side . . . . . .Modulus = L / 4.0
  - Applications. - The roun d bar of diameter =2x has the same modulus as a wall of thickness x. A rectangular bar of 100x50, has the same modulus as a round bar of diameter -67-

- **CORROSION RESISTANCE. -** Chemical reaction between the corrosive medium (normally atmospheric) and the exposed metal surface. The product of the reaction covers the surface (oxide) and the corrosion stops or continues depending on the nature of the surface compound formed.

- **DAMPING CAPACITY. -** Property of the materials to reduce the vibrations by lowering the impact energy absorbed.

- **DENSITY. -** 7200 Kg/m3 for flake cast iron, (see tables of physical properties).

  - Calculation of round bar

$$\text{Kgr/Metro} = \frac{d^2 \times \pi \times 0{,}0072}{4}$$

  - Calculation of rectangular bar Lmm (breadth) and lmm (height).

$$\text{Kgr/Metro} = L \times l \times 0{,}0072$$

  - Calculation of square bar L mm side

$$\text{Kgr/Metro} = L \times L \times 0{,}0072$$

- **DUCTILITY. -** Property that allows the permanent deformation of materials without breaking when submitted to stress. In metal materials, the concept of plasticity and ductility are similar.

- **ELASTICITY. -** Property that allows materials to be deformed, solely during the action of stress or compression loads. When these cease, the material acquires the form prior to deformation. In metal materials it is associated with concepts of Elasticity Modulus and Elastic Limit.

- **ELASTICITY MODULUS. -** Relationship between the elastic limit and induced elastic deformation (see Elastic Limit). In grey casting, there is no pure elastic behaviour. The values provided are conventional and refer to the deformation caused at a certain percentage of the maximum breaking load (approx. 75%).

- **ELASTIC LIMIT. -** During elastic deformation, the maximum stress supported by the sample in the tensile test (see "elasticity") is known as the elastic limit. The relationship between this load and the original section of the sample is calculated.

- **ELONGATION. -** Permanent deformation, which is measured in the samples in the test for tensile strength once the sample reaches the maximum breaking load. It is measured as a % of the original length of the sample.

- **FATIGUE STRENGTH. -** Strength of metals supporting variable or intermittent loads with values lower than the Elastic Limit. Theoretically a fixed load with these values would not result in plastic deformation but because the load is variable or intermittent this deformation can be produced. The Fatigue Limit concept expresses the maximum load that can be supported without deformation for a determined variability or intermittence of load.

- **FERRITE. -** Solid solution of carbon in alpha Fe. The % of C is very low. This structure is normally present alongside pearlite in the as-cast state. In casting it is easy to machine and has ductile properties which are superior to pearlite, in spite of possessing lower resistance

- **GRAPHITE MOULD. -** Permanent graphite mould used in continuous casting in order to give shape to the bar.

- **GREY CASTING. -** Alloy of iron with high %s of C and Si. Structurally composed of a metallic phase and another non-metallic phase, which is graphite.

- **HARDENING. -** Heat treatment of iron alloys which consists of heating to850-900 ºC, in order to achieve austenising, (obtain an austenitic structure,) followed by rapid cooling in order to produce a martensitic structure, (see "martensite" and "austempering"). The term surface hardening refers to the fact that this process only affects the surface of the part.

- **IMPACT RESISTANCE. -** The energy absorbed per surface unit of the specimen section in the resilience test. This test consists of the impact from a mass in movement (pendulum drop) with sufficient kinetic energy to break the sample. Units for example Jul/cm2.

- **INCLUSIONS. -** Non-metallic phases (oxides, sulphides, silicates, etc.) that are present in the alloy structures. Their large-scale accumulation constitutes a defect (see slag).

- **INOCULANTS. -** Elements that are added to the liquid casting (both laminar and nodular) in order to improve the nuclei. This results in an improvement in the structural homogeneity, as well as a greater machining facility by eliminating chill, (cementite).

- **LAMINAR GREY IRON -** This is grey iron when the non-metallic phase is present in the form of sheets of graphite. In common parlance it is often called by various names: simple grey cast iron, cast iron, etc.

- **MACHINABILITY. -** Ability of the metal materials to be submitted to the action of the tools in the machining operations.

- **MARTENSITE. -** Structure of acicular appearance, which is present in steels and cast iron when the hardening process is carried out. It is hard, (though not as hard as cementite,) and not very resistant. The tempering process accompanies the hardening process in order to produce tempered martensite, reducing its hardness and somewhat increasing its tensile strength

- **MATRIX. -** Fundamental constituent of the microstructure. In casting it is said that the structure consists of the metal matrix and the graphite (see "casting").

- **MILLING. -** Machining operation. This is used on square and rectangular continuous cast bars in order to clean the surface and improve its condition.

- **NODULARIZER. -** Element added to the liquid casting which is necessary for the graphite phase in the micro-structure to present the form of spheroids or nodules. That is to say, the nodularizer is the element that makes the casting nodular instead of laminar.

- **NORMALISED. -** Heat treatment in which the iron alloy is heated to a temperature higher than that of the ferrite-pearlite transformation and air-cooled, (with forced or unforced air, depending on the thickness of the part). This process is called the pearlising the material.

- **PEARLITE. -** Structure, normally lamellar, (known as eutectoid), which is characterised by the fact that the ferrite and the cementite are so closely linked that they form a new constituent called pearlite, (see ferrite). In spite of being harder than ferrite it is perfectly suitable for machining.

- **PEELED** See "surfacing".

- **PORES. -** Defects of the cavity type which are present in the metal or solid alloy as a consequence of the presence of gases dissolved in the liquid. These gases remain trapped in the liquid once their solubility drops, forming a bubble, which results in the hole. (Also known as BLOW HOLES.)

- **ROCKWELL HARDNESS. -** As hardness is the resistance of materials to penetration, the value of Rockwell hardness is determined by the difference between the penetration depths of 2 loads, (pre-load and load). These loads act on a ball of a given diameter or on a diamond cone. Depending on these load values and the penetration tool, we use the scale A, B or C.

- **SLAG. -** Constituent of the liquid baths of the metal alloys, produced in fusion processes for various reasons. Normally it is separated from the bath before proceeding to solidify the alloy. Its presence in the solid metal or alloy constitutes a serious defect.

- **SPHEROIDAL GREY IRON -** This is grey iron when the non-metallic phase is present in the form of spheroids or nodules of graphite. It is also called nodular iron or ductile iron.

- **TEMPERING. -** Low temperature annealing which accompanies the hardening process in order to produce drawn martensite, lowering the hardness and somewhat increasing tensile strength.

- **TENSILE STRENGTH. -** The maximum stress a material can withstand before breaking. The relationship between this maximum load and the surface of the original working section of the sample submitted to the tensile test is calculated.

- **THERMAL CONDUCTIVITY. -** Linearity constant from the general equation for heat transmission.

$$C.E. = \%C \frac{(\%Si+\%P)}{3}$$

where x is thickness of the transmission wall.

Where Δ T is difference of temperature between the two sides of the wall.

Where A is area of the transmission wall.

Conceptually it indicates the ability of a body to evacuate the heat it can receive.

- **TURNING. -** Machining operation. It is used on continuous cast round bars in order to smooth the surface and improve its condition and surface finish. Also known as Peeling.

- **WEAR RESISTANCE. -** Resistance of the solid bodies to the scouring of metal from the surface by means of a friction mechanism, generally of long duration. Normally it is associated with the structural components of the material.

COMPARATIVE TABLE OF HARDNESS AND RESISTANCE

BRINELL		ROCKWELL			SHORE	VICKERS
Imprint mm load 3.000 kg Sphere 10 mm	Hardness BH	Rc Diamond Cone 150 kg	Rb Sphere Inlet d=1 / 18 " 100 * g	Ra Diamond Cone 80 kg		Diamond Pyramid
(2,05)	(898,00)					
(2,10)	(857,00)					
(2,15)	(817,00)					
(2,20)	(780,00)	70			106	1150
(2,25)	(745,00)	68			100	1050
(2,30)	(712,00)	66			95	950
(2,35)	(682,00)	64		82,2	91	885
(2,40)	(653,00)	62		81,2	87	820
(2,45)	(627,00)	60		80,5	84	765
(2,50)	(601,00)	58		80,2	81	717
2,55	578	57		79,4	78	675
2,60	555	55	(120)	78,6	75	633
2,65	534	53	(119)	77,9	72	598
2,70	514	52	(119)	77,0	70	567
2,75	495	50	(117)	76,5	67	540
2,80	477	49	(117)	75,7	65	515
2,85	461	47	(116)	75,0	63	494
2,90	444	46	(115)	74,2	61	472
2,95	429	45	(115)	73,4	59	454
3,00	415	44	(114)	72,3	57	427
3,05	401	42	(113)	72,0	55	420
3,10	388	41	(112)	71,2	54	404
3,15	375	40	(112)	70,6	52	389
3,20	363	38	(110)	70,3	51	375
3,25	352	37	(110)	69,3	49	363
3,30	341	36	(109)	68,7	48	350
3,35	331	35	(109)	68,1	46	329
3,40	321	34	(108)	67,5	45	327

BRINELL		ROCKWELL			SHORE	VICKERS
Imprint mm load 3.000 kg Sphere 10 mm	Hardness BH	Rc Diamond Cone 150 kg	Rb Sphere Inlet d=1 / 18 " 100 * g	Ra Diamond Cone 80 kg		Diamond Pyramid
3,45	311	33	(108)	66,9	44	316
3,50	302	32	(107)	66,8	43	305
3,55	293	31	(106)	65,7	42	296
3,60	285	30	(105)	65,3	40	287
3,65	277	29	(104)	64,6	39	279
3,70	269	28	(104)	64,1	38	270
3,75	262	26	(103)	63,6	37	263
3,80	255	25	(102)	63,0	37	255
3,85	248	24	(102)	62,5	36	248
3,90	241	23	100	61,8	35	241
3,95	235	22	99	61,4	34	235
4,00	229	21	98	60,8	33	229
4,05	223	20	97		32	223
4,10	217	(18)	96		31	217
4,15	212	(17)	96		31	212
4,20	207	(16)	95		30	207
4,25	201	(15)	94		30	202
4,30	197	(13)	93		29	197
4,35	192	(12)	92		28	192
4,40	187	(10)	91		28	187
4,45	183	(9)	90		27	183
4,50	179	(8)	88		27	179
4,55	174	(7)	88		26	174
4,60	170	(6)	87		26	170
4,65	167	(4)	86		25	166
4,70	163	(3)	85		25	163
4,75	159	(2)	84		24	159
4,80	156	(1)	83		24	156

BRINELL		ROCKWELL			SHORE	VICKERS
Imprint mm load 3.000 kg Sphere 10 mm	Hardness BH	Rc Diamond Cone 150 kg	Rb Sphere Inlet d=1 / 18 " 100 * g	Ra Diamond Cone 80 kg		Diamond Pyramid
4,85	152		82		23	153
4,90	149		81		23	149
4,95	146		80		22	146
5,00	143		79		22	143
5,05	140		78		21	140
5,10	137		77		21	137
5,40	121		70			121
5,45	118		69			118
5,50	116		68			116
5,55	114		67			114
5,60	112		66			112
5,65	109		65			109
5,70	107		64			107
5,75	105		62			105
5,80	103		61			103
5,85	101		60			101
5,90	93		59			99
5-,95	87		57			97
6,00	83		56			95

CONVERSION FACTORS

Take	Multiply by	To get
Newtons/mm2	144	Pounds/inch2 (psi)
Kilograms	2.20	Pounds
Newtons	0.223	Pounds
Pounds	4.48	Newtons
Inches	2.54	Centimetres
Centimetres	0.394	Inches
Pounds	454	Grams
Grams	2.20x103	Pounds
Cubic Metre	3.278	Cubic Feet
Kg/Metre	0.672	Pounds/Foot
Grams/cc	0.036	Pounds/Inch3
Cubic Feet	1.728	Cubic Inch
Cubic Inch	5.87x10-4	Cubic Feet
Centimetre	0.0327	Feet
Feet	30.5	Centimetre
Pounds/inch2 (psi)	6.944x10-3	Newtons/mm2
This	**Equals**	**This**
1 Foot	0.305	Metres
1 Metre	3.278	Feet
1 MPa	1	N/mm2

TEMPERATURES

Fahrenheit to Celsius:

$$\frac{(^{o}F - 32)}{1,8} = {}^{o}C$$

Celsius to Fahrenheit:

$${}^{o}F = 1,8^{o}C + 32$$