



MALLEABLE CAST IRON THREADED FITTINGS

T E C H N I C A L M A N U A L

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1.1. THREADED JOINTS

Threaded joints between elements of conduction (fittings, steel pipes, valves, brackets,...) is regulated, with the following being the type of threads used:

- **Joining or Leakage Threads:** these threads themselves must provide the sealing of the joint, this is attained through the pressure of metal on metal which is produced between the flanges of the exterior tapered thread and the interior cylindrical thread when tightened and using an adequate pairing (the use of an appropriate sealant helps with the sealing of the joint given that it fills the unavoidable differences which are produced in the manufacturing of the theoretical thread profile).

This is carried out in accordance with the **EN 10226-1** standard, which is:

- **Internal threads:** parallel or cylindrical (called **Rp**).
- **External threads:** tapered (called **R**).

- **Fastening or tightening threads :** these threads themselves do not provide sealing of the union. They act as a simple fastening or tightening mechanical element. The sealing is achieved with the help of flat joints placed between flat metal faces (flat joints) or through metal surfaces conveniently assembled together joined (tapered joints).

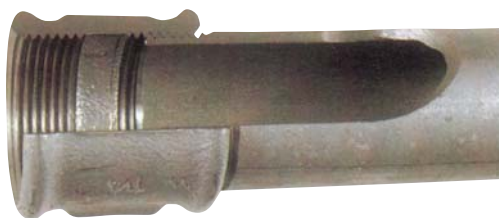
They are manufactured in accordance with the **EN ISO 228-1** standard under denomination **G**.

Special consideration must be given to the combination between a **type Rp** internal parallel threaded joint according to the EN 10226-1 standard and a **type G** (tolerance class A or B) external parallel fastening thread according to the EN ISO 228-1 standard. Such an occurrence must be specified and the fact that sealing may not necessarily be achieved has to be kept in mind.

PROFILE OF THE THREADED JOINT

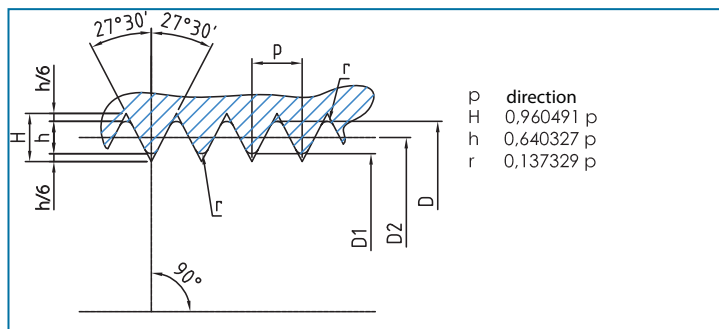
The dimensions, tolerances and labelling of tapered external threads and internal cylindrical threads in sealing joints meet all the requirements of the EN 10226-1 standard.

From a mechanical point of view, all tensile, compression and bending stresses on the threaded joints are absorbed by the metal on metal contact between the flanges and the threads of the joint.

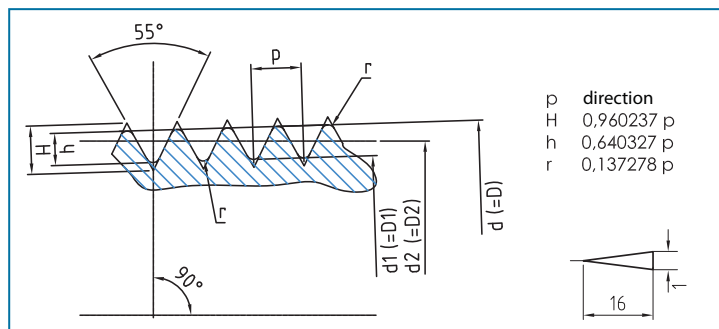


The profiles of the internal and external threads are shown in the following diagrams:

Internal Thread
Cross section of cylindrical thread (EN 10226-1)



External Thread
Cross section of conical thread (EN 10226-1)



In order to obtain a reliable thread the following factors have to be taken into account:

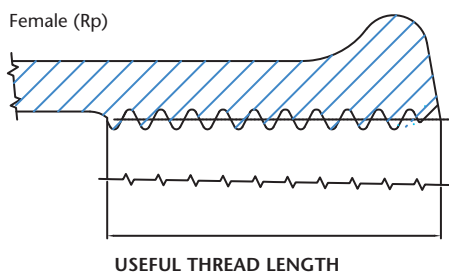
In the internal threads it is important to note that the useful thread must be of such a length that it allows the external thread to be introduced even when this has reached its maximum value.

In the external threads:

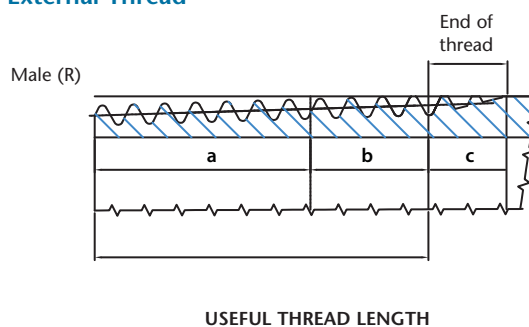
- The dimension "A" (calibre length) should be designed in such a way that even with the lowest internal thread diameter, the external thread should be able to be introduced and the sealing material can be applied. This length can be identified when manually tightening.
- The length of the thread (totally formed in the roots and in the majority of the crests) behind the gauge plane is the required length to withstand the pressure of the tool even with internal threads with maximum diameter. This length "b" is the length of the installation, and it is important to obtain a perfect tight joint on contact with the tool (always equal to or greater than $2\frac{3}{4}$ turns).
- The length "c", which starts after the end of "b", is known as the thread end (it is not completely formed in the roots) and must remain visible after contact with the tool. If this is tightened to the limit in such a way that the threads in the area can't be seen, there will be a serious risk of leakage and it indicates that the threaded joint is incorrect.

A graphical explanation of the aforementioned procedure :

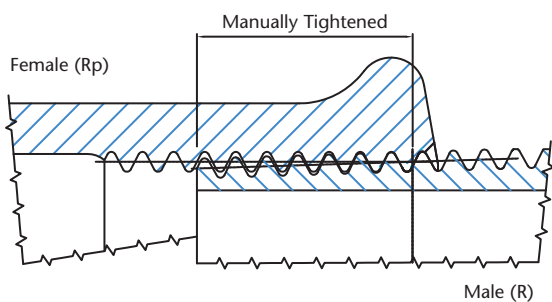
Internal Thread



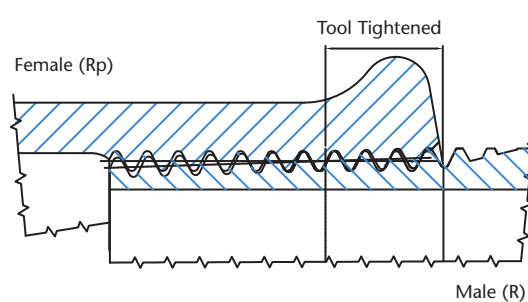
External Thread



Manually Tightened



Tool Tightened



In the diagram a manually tightened joint is shown (one can notice that there is still enough room in the external thread to apply tool pressure). Next, the final tightening with the tool can be seen, and the free end threads can be appreciated.

So, the tapered-cylindrical compression effect in the length ("a" + "b") obtains a perfect tight joint to which a small amount of sealant material must be added to cover the theoretical profile differences.

In the following table we present the dimensions and tolerances for the threaded joints and the basic threaded steel pipe dimensions of the medium and heavy weight range in accordance with the EN 10255 (old DIN 2440) standard.

Thread Size

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Thread Size	Number of threads in 25,4 mm	Pitch	Height of thread	Diameters at gauge plane			Gauge length (external thread)					Assembly length		Length of useful external thread not less than			Tolerance on position of gauge plane on internal thread		
		P	h	Major (gaude diameter)	Pitch	Minor	Nominal	Tolerance $T_1/2$		max.	min.	mm ^b	Turns of thread	for nominal gauge length	for maximum gauge length	for minimum gauge length	Tolerance $T_2/2$		Equivalent diametral tolerance ^a on parallel internal threads
		mm	mm	d=D	d ₂ =D ₂	d ₁ =D ₁	mm	mm ^b	Turns of thread	mm	mm			mm	mm	mm	mm ^b	Turns of thread	mm ^b
1/16	28	0,907	0,581	7,723	7,142	6,561	4	± 0,9	± 1	4,9	3,1	2,5	2 3/4	6,5	7,4	5,6	± 1,1	± 1 1/4	± 0,071
1/8	28	0,907	0,581	9,728	9,147	8,566	4	± 0,9	± 1	4,9	3,1	2,5	2 3/4	6,5	7,4	5,6	± 1,1	± 1 1/4	± 0,071
1/4	19	1,337	0,856	13,157	12,301	11,445	6	± 1,3	± 1	7,3	4,7	3,7	2 3/4	9,7	11	8,4	± 1,7	± 1 1/4	± 0,104
3/8	19	1,337	0,856	16,662	15,806	14,950	6,4	± 1,3	± 1	7,7	5,1	3,7	2 3/4	10,1	11,4	8,8	± 1,7	± 1 1/4	± 0,104
1/2	14	1,814	1,162	20,955	19,793	18,631	8,2	± 1,8	± 1	10,0	6,4	5,0	2 3/4	13,2	15	11,4	± 2,3	± 1 1/4	± 0,142
3/4	14	1,814	1,162	26,441	25,279	24,117	9,5	± 1,8	± 1	11,3	7,7	5,0	2 3/4	14,5	16,3	12,7	± 2,3	± 1 1/4	± 0,142
1	11	2,309	1,479	33,249	31,770	30,291	10,4	± 2,3	± 1	12,7	8,1	6,4	2 3/4	16,8	19,1	14,5	± 2,9	± 1 1/4	± 0,180
1 1/4	11	2,309	1,479	41,910	40,431	38,952	12,7	± 2,3	± 1	15,0	10,4	6,4	2 3/4	19,1	21,4	16,8	± 2,9	± 1 1/4	± 0,180
1 1/2	11	2,309	1,479	47,803	46,324	44,845	12,7	± 2,3	± 1	15,0	10,4	6,4	2 3/4	19,1	21,4	16,8	± 2,9	± 1 1/4	± 0,180
2	11	2,309	1,479	59,614	58,135	56,656	15,9	± 2,3	± 1	18,2	13,6	7,5	3 1/4	23,4	25,7	21,1	± 2,9	± 1 1/4	± 0,180
2 1/2	11	2,309	1,479	75,184	73,705	72,226	17,5	± 3,5	± 1 1/2	21,0	14,0	9,2	4	26,7	30,2	23,2	± 3,5	± 1 1/2	± 0,216
3	11	2,309	1,479	87,884	86,405	84,926	20,6	± 3,5	± 1 1/2	24,1	17,1	9,2	4	29,8	33,3	26,3	± 3,5	± 1 1/2	± 0,216
4	11	2,309	1,479	113,030	111,551	110,072	25,4	± 3,5	± 1 1/2	28,9	21,9	10,4	4 1/2	35,8	39,3	32,3	± 3,5	± 1 1/2	± 0,216
5	11	2,309	1,479	138,430	136,951	135,472	28,6	± 3,5	± 1 1/2	32,1	25,1	11,5	5	40,1	43,6	36,6	± 3,5	± 1 1/2	± 0,216
6	11	2,309	1,479	163,830	162,351	160,872	28,6	± 3,5	± 1 1/2	32,1	25,1	11,5	5	40,1	43,6	36,6	± 3,5	± 1 1/2	± 0,216

Note: The main dimensions were converted into millimetres on the basis of 1 inch= 25,4 mm, beginning with the number of threads per inch, which determines the pitch P, the formula h (the height of thread) = 0,640 327 P and the major diameter at the gauge plane. Pitch diameter and minor diameter were then compiled by subtracting once or twice respectively the height of thread h from the major diameter. The nominal gauge length, the tolerances and the assembly length were directly computed. The remaining lengths given in table 1 were obtained by subtracting or adding the tolerances or assembly length respectively to the nominal gauge length. Tolerances and assembly lengths are expressed in millimetres and in number of turns of thread.

¹ For parallel internally threaded parts the diametral tolerances are derived from the tolerances in column 19 by multiplying with the corresponding pitch in column 3 and with 1/16, the amount of taper.

² Informative tolerances, in millimetres, are obtained from the mandatory values in turns by multiplying with the corresponding pitch in column 3 and rounding to the nearest 0,1mm.

Medium weight steel tubing (EN 10255) Standard which does not conform to the following norms:

UNE 19-040 Normal weight	UNE 19-047 UNE 19-051 UNE 36-864	↔	DIN 2440 and ISO 65 Medium weight
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Heavy weight steel tubing (EN 10255) Standard which does not conform to the following norms:

UNE 19-041 Stolen weightened	↔	DIN 2441 e ISO 65 Stolen weightened
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Thread size	Nominal diameter DN (1)	Inferior diameter mm	Exterior diameter			Espesor de pared	Masa kg/m	
			Theoretical	Maximum	Minimum		Black tube	Galvanized tube
3/8	DN 10	12,6	17,2	17,5	16,7	2,3	0,84	0,88
1/2	DN 15	16,1	21,3	21,8	21,0	2,6	1,21	1,25
3/4	DN 20	21,7	26,9	27,3	26,5	2,6	1,56	1,6
1	DN 25	27,3	33,7	34,2	33,3	3,2	2,41	2,48
1 1/4	DN 32	36,0	42,4	42,9	42,0	3,2	3,10	3,19
1 1/2	DN 40	41,9	48,3	48,8	47,9	3,2	3,56	3,70
2	DN 50	53,1	60,3	60,8	59,7	3,6	5,03	5,18
2 1/2	DN 65	68,9	76,1	76,6	75,3	3,6	6,42	6,62
3	DN 80	80,9	88,9	89,5	88,0	4,0	8,36	8,59
4	DN 100	105,3	114,3	115,0	113,1	4,5	12,20	12,50
5	DN 125	129,7	139,7	140,8	138,5	5,0	16,60	16,90
6	DN 150	155,1	165,1	166,5	166,5	5,0	19,80	20,10

Thread size	Nominal diameter DN (1)	Inferior diameter mm	Exterior diameter			Espesor de pared	Masa kg/m	
			Theoretical	Maximum	Minimum		Black tube	Galvanized tube
3/8	DN 10	11,4	17,2	17,5	16,7	2,9	1,02	1,07
1/2	DN 15	14,9	21,3	21,8	21,0	3,2	1,44	1,49
3/4	DN 20	20,5	26,9	27,3	26,5	3,2	1,87	1,94
1	DN 25	25,7	33,7	34,2	33,3	4,0	2,93	3,02
1 1/4	DN 32	34,4	42,4	42,9	42,0	4,0	3,79	3,90
1 1/2	DN 40	40,3	48,3	48,8	47,9	4,0	4,37	4,54
2	DN 50	51,3	60,3	60,8	59,7	4,5	6,19	6,37
2 1/2	DN 65	67,1	76,1	76,6	75,3	4,5	7,93	8,18
3	DN 80	78,9	88,9	89,5	88,0	5,0	10,30	10,58
4	DN 100	103,5	114,3	115,0	113,1	5,4	14,50	14,86
5	DN 125	128,9	139,7	140,8	138,5	5,4	17,90	18,22
6	DN 150	154,3	165,1	166,5	163,9	5,4	21,30	21,62

1.2. BASIC TECHNICAL CHARACTERISTICS

STANDARD OF THE PRODUCT

Malleable Cast iron grooved fittings meet the requirements of the European product standard EN 10242 and international standard ISO 49.

The EN 10242 standard has been adopted by many European countries as a national standard (UNE EN 10242, DIN EN 10242, UNI EN 10242...) and has substituted the old national standard UNE 19491, DIN 2950...

BASE MATERIAL

Malleable cast iron is basically an alloy of iron and carbon in which free graphite appears during solidification and in the cooling process. In this way, the properties of cast iron are obtained designated in terms of resistance to traction and percentage elongation. The material in question withstands impacts well, can flex well without breaking (ductility) at low temperatures as well having interesting soldering properties.

The initial cast iron (**white heart malleable cast iron** with a graphite free structure) is very hard, which makes its mechanisation very difficult. Because of this, and in order to obtain a final structure with good mechanization, good ductility and appropriate mechanical properties, a thermal annealing or malleablizing treatment is performed, through which two different types of malleable cast iron can be produced:

- **White heart malleable cast iron:** obtained by decarburizing the white heart at high temperatures (approx. 1060°C) in an oxidizing atmosphere for long time cycles. The resulting material will be greatly reduced in carbon, even in thin pieces, obtaining a ferrite structure which is totally free of graphite. On the other hand, in very thick pieces graphite may exist in the central zones. Any remaining graphite will be in the form of "temper carbon".
- **Black heart malleable cast iron:** obtained by annealing in an inert atmosphere (vacuum, inert gas,...) in several phases at temperatures of 750° - 950°C for time cycles inferior than those of white heart. The resulting material presents a uniform microstructure with graphite nodes in the form of "temper carbon".

As a consequence of the different thermal treatment undergone, the white heart malleable cast iron has major advantages over that of black heart such as:

- Better galvanization (Fe-Zn alloy) given that the microstructure of the white heart is more ferrite on the surface (presence of pure iron).
- Better mechanical properties (better resistance to traction for similar elongations).
- The possibility to obtain, after additional thermal treatments, a material that can be soldered.

ATUSA mainly manufactures EN-GJMW-400-05 in accordance with the EN-GJMW-400-05 standard. This means that a test bar with a diameter of 12mm presents the following properties:

- Minimum Tensile Strength (Rm) : 400 MPa
- Minimum Elongation Percentage ($A_{3,4}$) : 5%
- Elastic Limit ($R_{p0,2}$) : 220 MPa
- Maximum Brinell Hardness : 220 HB

The malleability obtained for our fittings guarantees that no cracks will appear after the flattening of cylindrical sections. Thus, after the flattening of a:

- Fitting of up to 2": a diameter distortion of 10% without the appearance of cracks is guaranteed.
- Fitting over 2": a diameter distortion of 5% without the appearance of cracks is guaranteed

Note: some fittings may be supplied in steel, providing the same properties as those of malleable cast iron.

SURFACE COATING

The fittings can be provided with two types of finish:

- **Black coating:** the fittings are finished without surface treatment after being annealed or malleablized.
- **Galvanized coating:** after thermal treatment, the fittings undergo hot dip galvanization in a zinc bath, obtaining a continuous surface, without any chips, burr or metallic residue.

Nevertheless, after mechanisation and unitary leakage control, and in order to remove shavings, cutting oils and other dirt, the fittings are subjected to a grease removal process which provides them with a temporary layer of antioxidant protection. This ensures that the final surface is free of polycyclic aromatic hydrocarbons (PAHs).

Note: steel fittings, which can be finished in black or electro zinc, are an exception.

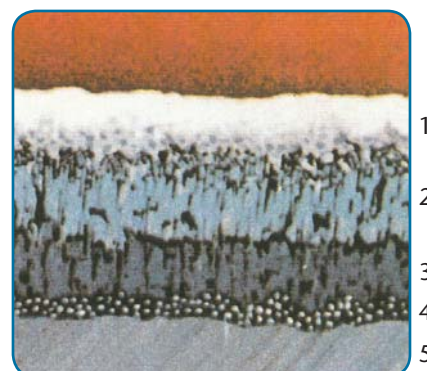
GALVANIZATION

Galvanization of the fittings is carried out through a process of hot dip immersion in accordance with the specifications of the EN 10242 standard.

The metal base of the white heart fittings forms an alloy (Fe-Zn), with the zinc in layers as shown in the diagram:

Micrograph (cross section of a hot dip galvanized white heart fitting)

- LAYER 1:** (eta) pure zinc, exterior surface
- LAYER 2:** (zeta) Fe-Zn (5.8% - 6.8% Fe content)
- LAYER 3:** (delta) Fe-Zn (7% - 12% Fe content)
- LAYER 4:** (gamma) Fe-Zn (21% - 28% Fe content)
- (5) NUCLEUS:** base material, interior



In this way, and without just being a “simple layer or exterior coating”, galvanization applied to the surface of the fittings is an intimate union which always forms part of the material. Hence, it provides very high protection against corrosion and makes the product especially recommended for use in drinking water installations.

The mass of the alloy is over 500gr/m² and has a minimum thickness of 70 micros, which is very high when compared with other protection methods (electro zinc).

The alloy is even harder than steel, which, with its zinc exterior (softer), makes the joint form a “cushioning” system which is able to withstand blows and abrasion.

DESIGN

The “Design Symbol” of the design of the fittings allows identification according to the selection of the material and the type of thread chosen. Consequently; **ATUSA** manufactures its fittings mainly in accordance with design type A, which means:

- Tapered exterior threads.
- Parallel or cylindrical interior threads.
- EN-GJMW-400-05 standard material (white heart malleable cast iron).

Design symbol	Type of thread		Material degree
	Tapered external	Parallel internal	
A	R	Rp	EN-GJMW-400-5

SEALANTS

The role of the sealing material used in the (tapered-cylindrical) threaded joint is to fill the unavoidable differences which are produced in the manufacturing of the theoretical thread profile.

The product to use should be chosen on the basis of the conduction material, of the fluid to be conducted, and of the pressure and temperature conditions. Attention should also be given to the instructions of the manufacturer. Thus, the EN 751 standard (*sealing materials for metallic threaded joints* in contact with 1st, 2nd and 3rd family gases and hot water) specifies the characteristics of the sealing materials for threaded joints in contact with gases and hot water (moreover, there are other materials on the market which are adapted to cater for different fluids such as air, combustible liquids, oils, etc.)

1.3. CERTIFICATION

Amongst others, ATUSA holds the following certificates:



Quality Management Certification in accordance with standard UNE-EN ISO 9001:2008, issued by AENOR.



Implementation and maintenance of Quality Management for the manufacturing of Malleable Cast Iron Fittings.



Certification for the manufacturing of Malleable Cast Iron Threaded Fittings in accordance with the UNE-EN ISO 10242 Standard (Design symbol "A") in the Salvatierra factory (Spain), issued by AENOR.



Certification for Malleable Cast Iron Threaded Fittings in accordance with the DIN-EN 10242 Standard (Design symbol "A") for their use in the supply of gases, issued by DVGW.



Certification for Malleable Cast Iron Threaded Fittings in accordance with the DIN-EN 10242 Standard (Design symbol "A") for their use in the supply of gases, issued by SVGW.



Certification for Malleable Cast Iron Threaded Fittings in accordance with the FM Approvals Standard 1920 for their use in fire prevention installations.

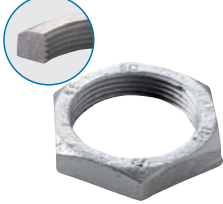
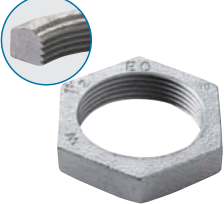
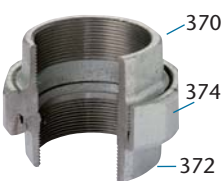
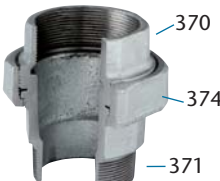
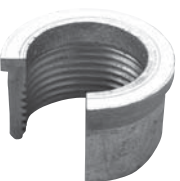


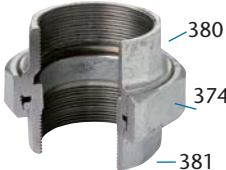
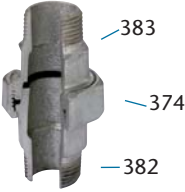
Certification of Conformity of Production of Galvanized Malleable Cast Iron Fittings products in accordance with UNE-EN 10242 (EO brand) for their use in the supply of fluids and gases in agreement with that required by the Royal Decree 2531/1985 and the 13.01.1999 Ministerial Order issued by the Ministry of Industry.



Sanitary Registration for Malleable Cast Iron Threaded Products in agreement with Annex IX of the Royal Decree 140/2003 issued by the Ministry of Health.



					
1	1A	2	2A	3	40
					
92	92R	94	95	96	97
					
131	132	133	134	135	165
					
241	245	246	270	271	280
					
310	312	320	321	330	331
					
372	374	380	381	382	383

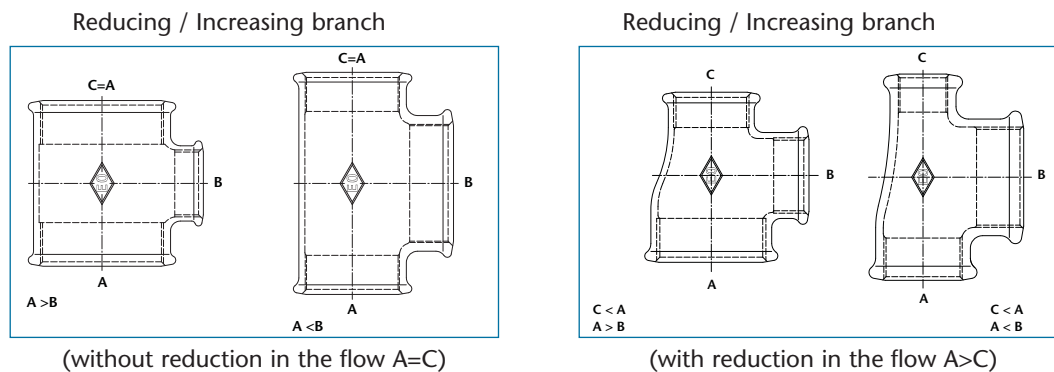
				
41	60	85	90	90R
				
98	120	121	130	130R
				
180	220	221	223	240
				
281	290	291	294	300
				
340	341	344	370	371
				
471	526	529A	531	596

NAMING THE FIGURES

The designation of the size of the fittings is carried out in the following way:

- Position/place the mouth of the water flow with the greatest diameter on a flat surface (ground)
- The mouth of the branch/ shunt (increasing or reducing) is placed facing the right.

The denomination will start with the "ground" mouth and continue anticlockwise.



1. Fittings with equal sized mouths

Regardless of the number of mouths, the designation will be unique.
The denomination will be: **A"**

2. Fittings with two different sized mouths (reductions)

The denomination will be: **A" - B"**, where A is always bigger than B.

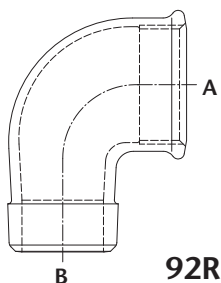
3. Fittings with more than two mouths, not all the same size, with no reduction in the flow.

In this case, the two mouths of the water flow are the same. It will be designated indicating the size of the two similar mouths (flow) followed by the size of the branch (regardless of whether this is bigger or smaller).
The denomination will be: **A" - B" - A"**, where A may be bigger or smaller than B (in practice this is usually designated A" - B")

4. Fittings with more than two mouths, not all the same size, with reduction in the flow.

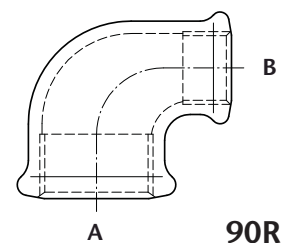
In this situation, the two mouths of the flow are different. It will be designated indicating the size of the mouths beginning with the flow of water mouth with the biggest diameter and following an anticlockwise direction.
The denomination will be: **A" - B" - C"**, where A may be bigger than C (B may be greater or smaller than A).

5. Special Cases: (Fig 92R, reducing elbow and Fig 90R , reducing elbow)

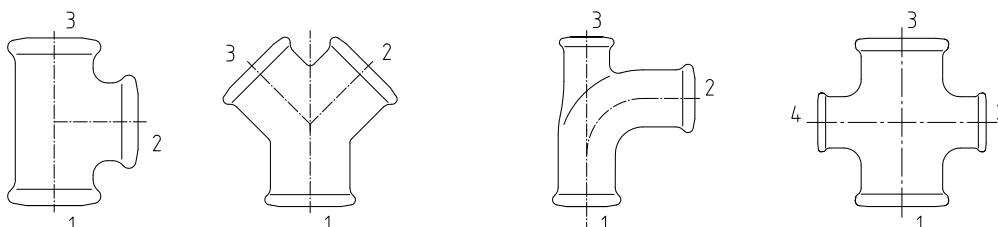


Reduction in male mouth ($A > B$)
- Designation: 92R - A" - B" (A= female; B= male)

Reduction in female mouth ($B > A$)
- Designation: 92R - A" - B" (A= female; B= male)



Anyway, always remember that the denomination will always follow an anticlockwise direction.



MARKINGS

Generally, all our fittings are marked during the modelling process with:

- Logotype EO
- Dimensions (in inches)
- Model number (identifiable from its position in the tools)
- W: (White) identifying that it is a white heart fitting

DIMENSIONS AND TOLERANCES

The fittings have the appropriate dimensions according to the EN 10242 standard and these are shown in the accompanying dimension tables.

Longitude tolerances: when the maximum and minimum dimensions are not specified, these can be found in the following table:

Dimension mm.		Tolerance
0	≤ 30	± 1,5
> 30	≤ 50	± 2,0
> 50	≤ 75	± 2,5
> 75	≤ 100	± 3,0
> 100	≤ 150	± 3,5
> 150	≤ 200	± 4,0
> 200		± 5,0

Note:

- For straight fittings, the tolerance refers to the distance between faces.
- For curved fittings, the tolerance refers to the distance between the face and the centre.
- For joints, the tolerance refers to the individual components, not to the assembled joint.

Angular Tolerances (thread alignment): the axes of the threads will have a maximum deviation of between +/- 0.5° with regard to the specified angle.

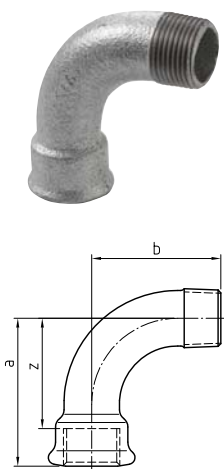
Storage For The Tightening Tool: the dimensions of the flat surfaces for the storage of the key depend on the design and are not regulated. However, the minimum width for the storage of the tightening key, measured in the corners, will be specified in the following table:

Nominal Diameter DN	6	8	10	15	20	25	32	40	50	65	80	100	125	150
Designation of size of thread	1/8"	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"
Length of coupling in mm.	7	10	10	13	15	17	19	19	24	27	30	36	40	40

1

(G4)

LONG SWEEP BEND M/F



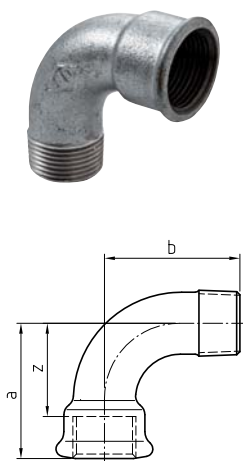
SIZE	CODE	DIMENSIONS (mm)			Weight (gr)	
		a	b	z		
1/8"	01001/5000	35	32	28	28	
1/4"	01001/5001	40	36	30	56	
3/8"	01001/5002	48	42	38	68	
1/2"	01001/5003	55	48	42	145	
3/4"	01001/5004	69	60	54	215	
1"	01001/5005	85	75	68	382	
1 1/4"	01001/5006	105	95	86	650	
1 1/2"	01001/5007	116	105	97	785	
2"	01001/5008	140	130	116	1351	
2 1/2"	01001/5009	176	165	149	2241	
3"	01001/500A	205	190	175	3635	
4"	01001/500C	260	245	224	4886	

1/5 - 1= Black - 5= Galvanized

1A

(D4)

SHORT BEND M/F



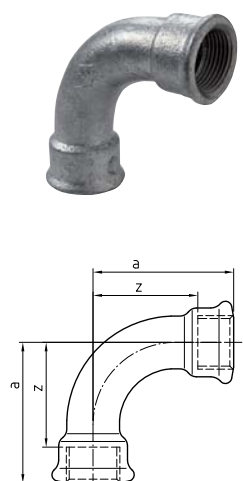
SIZE	CODE	DIMENSIONS (mm)			Weight (gr)	
		a	b	z		
1/4"	01A01/5001	30	30	20	67	
3/8"	01A01/5002	36	36	26	81	
1/2"	01A01/5003	45	45	32	98	
3/4"	01A01/5004	50	50	35	164	
1"	01A01/5005	63	63	46	254	
1 1/4"	01A01/5006	76	76	57	438	
1 1/2"	01A01/5007	85	85	66	572	
2"	01A01/5008	102	102	78	988	
2 1/2"	01A01/5009	115	115	88	1610	
3"	01A01/500A	127	127	97	2585	
4"	01A01/500C	165	165	129	4350	

1/5 - 1= Black - 5= Galvanized

2

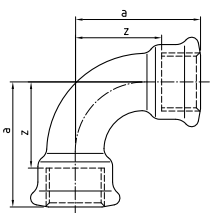
(G1)

LONG SWEEP BEND F/F



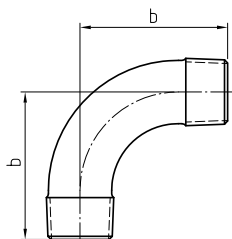
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
1/4"	02001/5001	40	30	72	
3/8"	02001/5002	48	38	80	
1/2"	02001/5003	55	42	168	
3/4"	02001/5004	69	54	262	
1"	02001/5005	85	68	450	
1 1/4"	02001/5006	105	86	710	
1 1/2"	02001/5007	116	97	855	
2"	02001/5008	140	116	1545	
2 1/2"	02001/5009	176	149	2513	
3"	02001/500A	205	175	3807	
4"	02001/500C	260	224	5066	

1/5 - 1= Black - 5= Galvanized

2A
(D1)
SHORT BEND F/F


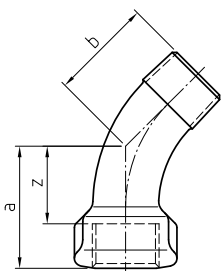
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
3/8"	02A01/5002	36	26	122	
1/2"	02A01/5003	45	32	124	
3/4"	02A01/5004	50	35	195	
1"	02A01/5005	63	46	270	
1 1/4"	02A01/5006	76	57	462	
1 1/2"	02A01/5007	85	66	599	
2"	02A01/5008	102	78	1560	
2 1/2"	02A01/5009	115	88	2100	
3"	02A01/500A	127	97	2630	
4"	02A01/500C	165	129	6290	

1/5 - 1= Black - 5= Galvanized

3
(G8)
LONG SWEEP BEND M/M


SIZE	CODE	DIMENSIONS (mm)	Weight (gr)	
		b		
1/4"	03001/5001	36	30	
3/8"	03001/5002	42	60	
1/2"	03001/5003	48	88	
3/4"	03001/5004	60	162	
1"	03001/5005	75	36	
1 1/4"	03001/5006	95	488	
1 1/2"	03001/5007	105	632	
2"	03001/5008	130	1074	
2 1/2"	03001/5009	165	1846	
3"	03001/500A	190	1962	
4"	03001/500C	245	5995	

1/5 - 1= Black - 5= Galvanized

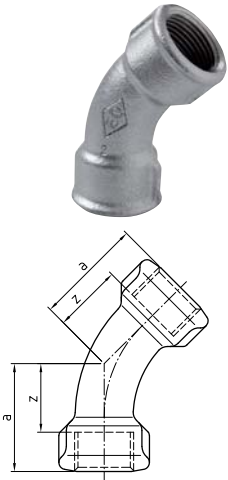
40
(G4/45°)
LONG SWEEP BEND M/F 45°


SIZE	CODE	DIMENSIONS (mm)			Weight (gr)	
		a	b	z		
1/4"	04001/5001	26	21	16	37	
3/8"	04001/5002	30	24	20	66	
1/2"	04001/5003	36	30	23	106	
3/4"	04001/5004	43	36	28	156	
1"	04001/5005	51	42	34	235	
1 1/4"	04001/5006	64	54	45	478	
1 1/2"	04001/5007	68	58	49	524	
2"	04001/5008	81	70	57	819	
2 1/2"	04001/5009	99	86	72	1295	
3"	04001/500A	113	100	83	1980	
4"	04001/500C	142	126	106	3750	

1/5 - 1= Black - 5= Galvanized

41 (G1/45°)

LONG SWEEP BEND F/F 45°

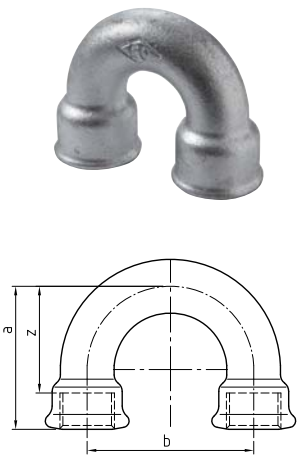


SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
1/4"	04101/5001	26	16	52	
3/8"	04101/5002	30	20	88	
1/2"	04101/5003	36	23	141	
3/4"	04101/5004	43	28	194	
1"	04101/5005	51	34	293	
1 1/4"	04101/5006	64	45	550	
1 1/2"	04101/5007	68	49	601	
2"	04101/5008	81	57	931	
2 1/2"	04101/5009	99	72	1456	
3"	04101/500A	113	83	2160	
4"	04101/500C	142	106	4254	

1/5 - 1= Black - 5= Galvanized

60

RETURN BEND

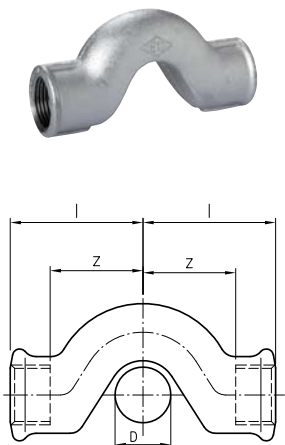


SIZE	CODE	DIMENSIONS (mm)			Weight (gr)	
		a	b	z		
1/2"	06001/5003	45	38	32	187	
3/4"	06001/5004	52	50	37	382	
1"	06001/5005	64	64	47	566	
1 1/4"	06001/5006	73	76	54	705	
1 1/2"	06001/5007	80	89	61	970	
2"	06001/5008	90	102	66	1395	

1/5 - 1= Black - 5= Galvanized

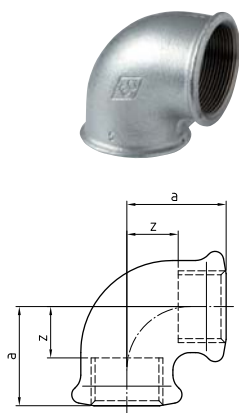
85

CROSSOVER



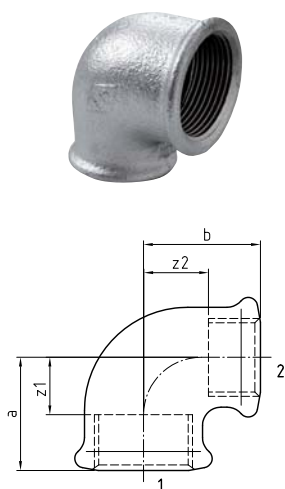
SIZE	CODE	DIMENSIONS (mm)			Weight (gr)	
		l	D	z		
3/8"	08501/5002	38	3/8	28	118	
1/2"	08501/5003	46	1/2	33	150	
3/4"	08501/5004	56	3/4	41	362	
1"	08501/5005	70	1	53	523	
1 1/4"	08501/5006	85	1 1/4	66	862	

1/5 - 1= Black - 5= Galvanized

90
(A1)
ELBOW F/F 90°


SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
1/8"	09001/5000	19	12	32	
1/4"	09001/5001	21	11	43	
3/8"	09001/5002	25	15	69	
1/2"	09001/5003	28	15	110	
3/4"	09001/5004	33	18	129	
1"	09001/5005	38	21	177	
1 1/4"	09001/5006	45	26	354	
1 1/2"	09001/5007	50	31	394	
2"	09001/5008	58	34	603	
2 1/2"	09001/5009	69	42	1064	
3"	09001/500A	78	48	1413	
4"	09001/500C	96	60	2387	
5"	09001/500D	115	75	4197	
6"	09001/500E	131	91	6000	

1/5 - 1= Black - 5= Galvanized

90R
(A1)
REDUCING ELBOW F/F 90°


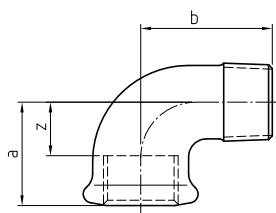
SIZE	CODE	DIMENSIONS (mm)				Weight (gr)	
		a	b	z1	z2		
3/8" - 1/4"	09001/5021	23	23	13	13	48	
1/2" - 1/4"	09001/5031	24	24	11	14	68	
1/2" - 3/8"	09001/5032	26	26	13	16	64	
3/4" - 3/8"	09001/5042	28	28	13	18	87	
3/4" - 1/2"	09001/5043	30	31	15	18	98	
1" - 1/2"	09001/5053	32	34	15	21	120	
1" - 3/4"	09001/5054	35	36	18	21	149	
1 1/4" - 1/2"	09001/5063	35	38	16	25	177	
1 1/4" - 3/4"	09001/5064	36	41	17	26	254	
1 1/4" - 1"	09001/5065	40	42	21	25	310	
1 1/2" - 3/4"	09001/5074	38	44	19	29	262	
1 1/2" - 1"	09001/5075	42	46	23	29	282	
1 1/2" - 1 1/4"	09001/5076	46	48	27	29	414	
2" - 1"	09001/5085	44	52	20	35	380	
2" - 1 1/4"	09001/5086	48	53	24	34	456	
2" - 1 1/2"	09001/5087	52	55	28	36	494	
2 1/2" - 2"	09001/5098	61	66	34	42	910	

1/5 - 1= Black - 5= Galvanized

92

(A4)

ELBOW M/F 90°



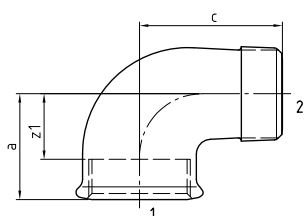
SIZE	CODE	DIMENSIONS (mm)			Weight (gr)	
		a	b	z		
1/8"	09201/5000	19	25	12	23	
1/4"	09201/5001	21	28	11	37	
3/8"	09201/5002	25	32	15	61	
1/2"	09201/5003	28	37	15	96	
3/4"	09201/5004	33	43	18	126	
1"	09201/5005	38	52	21	200	
1 1/4"	09201/5006	45	60	26	390	
1 1/2"	09201/5007	50	65	31	408	
2"	09201/5008	58	74	34	616	
2 1/2"	09201/5009	69	88	42	1178	
3"	09201/500A	78	98	48	1619	
4"	09201/500C	96	118	60	2300	

1/5 - 1= Black - 5= Galvanized

92R

(A4)

REDUCING ELBOW M/F 90°

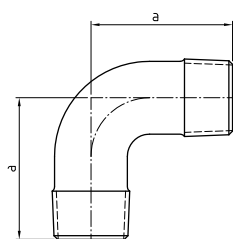


SIZE	CODE	DIMENSIONS (mm)			Weight (gr)	
		a	c	z1		
1/2" - 3/8"	09201/5032	26	33	13	56	
3/4" - 1/2"	09201/5043	30	40	15	96	
1" - 3/4"	09201/5054	35	46	18	180	
1 1/4" - 1"	09201/5065	40	56	21	255	
1 1/2" - 1"	09201/5075	47	62	28	361	
1 1/2" - 1 1/4"	09201/5076	52	64	33	345	
3/8" - 1/2"	09201/5023	28	37	18	99	
1/2" - 3/4"	09201/5034	34	42	21	150	
3/4" - 1"	09201/5045	39	50	24	234	
1" - 1 1/4"	09201/5056	44	59	27	351	

1/5 - 1= Black - 5= Galvanized

94

ELBOW M/F 90°

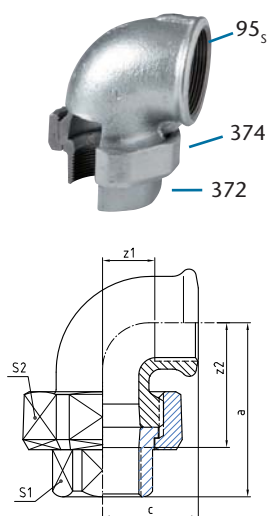


SIZE	CODE	DIMENSIONS (mm)	Weight (gr)	
		a		
3/8"	09401/5002	29	37	
1/2"	09401/5003	37	65	
3/4"	09401/5004	40	106	
1"	09401/5005	47	185	
1 1/4"	09401/5006	56	295	
1 1/2"	09401/5007	59	341	
2"	09401/5008	68	564	

1/5 - 1= Black - 5= Galvanized

95 (UA1)

UNION ELBOW FLAT SEAT F/F

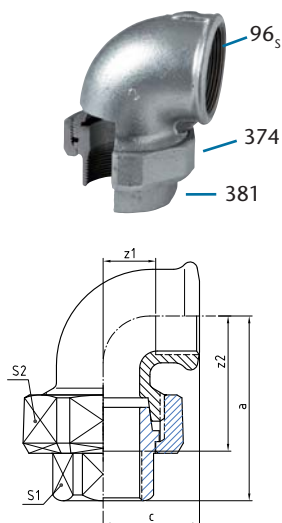


SIZE	374G	CODE	DIMENSIONS (mm)							Weight (gr)
			a	c	z1	z2	s1	s2	s2 máx	
3/8"	3/4"	09501/5002	52	25	15	42	12	32	36	143
1/2"	1 1/8"	09501/5003	58	28	15	45	26	44	44	281
3/4"	1 1/4"	09501/5004	62	33	18	47	32	48	50	359
1"	1 1/2"	09501/5005	72	38	21	55	38	54	55	507
1 1/4"	2"	09501/5006	82	45	26	63	48	68	70	826
1 1/2"	2 1/4"	09501/5007	90	50	31	71	54	74	75	931
2"	2 3/4"	09501/5008	100	58	34	76	66	89	90	1404

1/5 - 1= Black - 5= Galvanized

96 (UA11)

UNION ELBOW, TAPER SEAT F/F

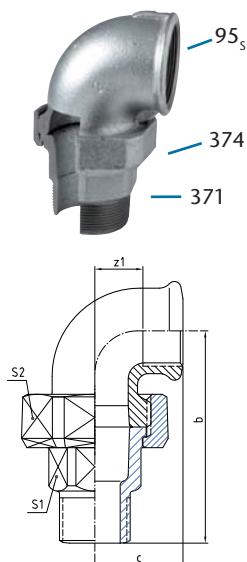


SIZE	374G	CODE	DIMENSIONS (mm)							Weight (gr)
			a	c	z1	z2	s1	s2	s2 máx	
1/4"	5/8"	09601/5001	48	21	11	38	18	31	32	116
3/8"	7/8"	09601/5002	52	25	15	42	22	35	36	176
1/2"	1 1/8"	09601/5003	58	28	15	45	26	44	44	291
3/4"	1 1/4"	09601/5004	62	33	18	47	32	48	50	373
1"	1 1/2"	09601/5005	72	38	21	55	38	54	55	491
1 1/4"	2"	09601/5006	82	45	26	63	48	68	70	881
1 1/2"	2 1/4"	09601/5007	90	50	31	71	54	74	75	973
2"	2 3/4"	09601/5008	100	58	34	76	66	89	90	1515
2 1/2"	3 1/2"	09601/5009	112	70	43	85	86	110	110	2407
3"	4"	09601/500A	135	78	48	105	98	130	130	3389

1/5 - 1= Black - 5= Galvanized

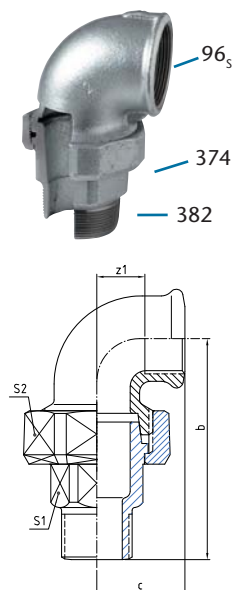
97 (UA2)

UNION ELBOW, FLAT SEAT M/F



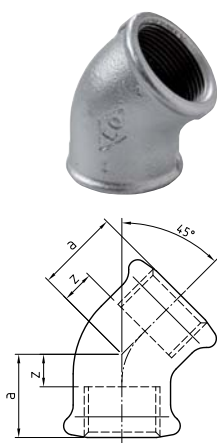
SIZE	374G	CODE	DIMENSIONS (mm)						Weight (gr)
			b	c	z1	s1	s2	s2 máx	
3/8"	3/4"	09701/5002	65	25	15	19	32	36	146
1/2"	1 1/8"	09701/5003	76	28	15	25	44	44	303
3/4"	1 1/4"	09701/5004	82	33	18	32	48	50	400
1"	1 1/2"	09701/5005	94	38	21	38	54	55	582
1 1/4"	2"	09701/5006	107	45	26	48	68	70	930
1 1/2"	2 1/4"	09701/5007	115	50	31	54	74	75	1091
2"	2 3/4"	09701/5008	128	58	34	66	89	90	1670

1/5 - 1= Black - 5= Galvanized

98
(UA12)
UNION ELBOW, TAPER SEAT M/F


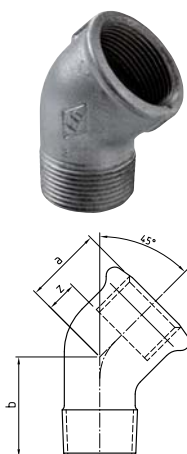
SIZE	374G	CODE	DIMENSIONS (mm)						Weight (gr)	
			b	c	z1	s1	s2	s2 máx		
1/4"	5/8"	09801/5001	61	21	11	15	28	32	132	
3/8"	7/8"	09801/5002	65	25	15	22	35	36	186	
1/2"	1 1/8"	09801/5003	76	28	15	26	44	44	311	
3/4"	1 1/4"	09801/5004	82	33	18	32	48	50	412	
1"	1 1/2"	09801/5005	94	38	21	38	54	55	576	
1 1/4"	2"	09801/5006	107	45	26	48	68	70	959	
1 1/2"	2 1/4"	09801/5007	115	50	31	54	74	75	1135	
2"	2 3/4"	09801/5008	128	58	34	66	89	90	1737	
2 1/2"	3 1/2"	09801/5009	145	70	43	86	110	110	2560	
3"	4"	09801/500A	160	78	48	98	130	130	3882	

1/5 - 1= Black - 5= Galvanized

120
(A1/45°)
ELBOW F/F 45°


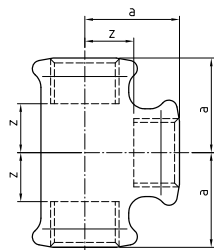
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
3/8"	12001/5002	20	10	50	
1/2"	12001/5003	22	9	98	
3/4"	12001/5004	25	10	122	
1"	12001/5005	28	11	165	
1 1/4"	12001/5006	33	14	258	
1 1/2"	12001/5007	36	17	366	
2"	12001/5008	43	19	564	
2 1/2"	12001/5009	48	21	840	
3"	12001/500A	54	24	1190	

1/5 - 1= Black - 5= Galvanized

121
(A4/45°)
ELBOW M/F 45°


SIZE	CODE	DIMENSIONS (mm)			Weight (gr)	
		a	b	z		
3/8"	12101/5002	20	25	10	44	
1/2"	12101/5003	22	28	9	82	
3/4"	12101/5004	25	32	10	114	
1"	12101/5005	28	37	11	164	
1 1/4"	12101/5006	33	43	14	265	
1 1/2"	12101/5007	36	46	17	330	
2"	12101/5008	43	55	19	570	
2 1/2"	12101/5009	46	54	19	770	
3"	12101/500A	52	61	22	1100	

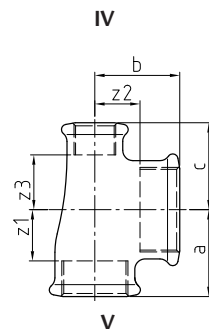
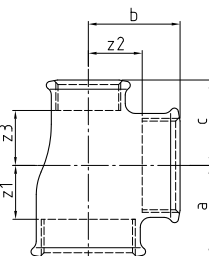
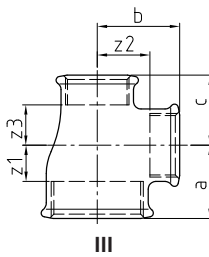
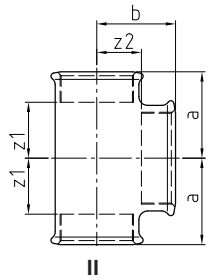
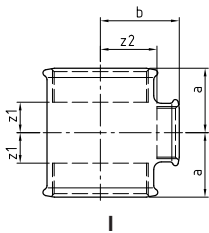
1/5 - 1= Black - 5= Galvanized

130
(B1)
TEE


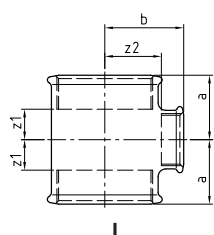
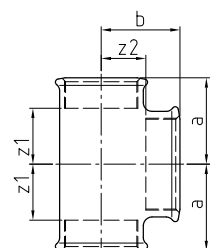
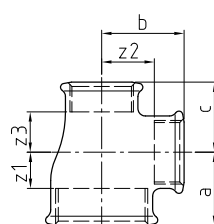
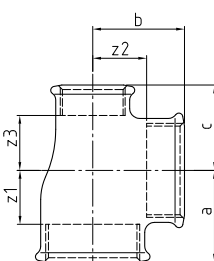
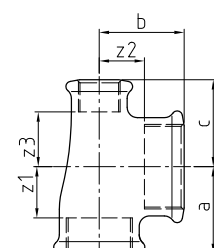
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
1/8"	13001/5000	19	12	40	
1/4"	13001/5001	21	11	55	
3/8"	13001/5002	25	15	87	
1/2"	13001/5003	28	15	150	
3/4"	13001/5004	33	18	191	
1"	13001/5005	38	21	267	
1 1/4"	13001/5006	45	26	433	
1 1/2"	13001/5007	50	31	554	
2"	13001/5008	58	34	840	
2 1/2"	13001/5009	69	42	1409	
3"	13001/500A	78	48	1807	
4"	13001/500C	96	60	3491	
5"	13001/500D	115	75	5625	
6"	13001/500E	131	91	8000	

1/5 - 1= Black - 5= Galvanized

- I: Tes iguales en paso y reducidas en bifurcación (A= C>B)
 II: Tes iguales en paso y aumentadas en bifurcación (A= C<B)
 III: Tes reducidas en paso y en bifurcación (A>B y A>C; B= C ó B>C ó B<C)
 IV: Tes reducidas en paso e iguales en bifurcación (A= B>C)
 V: Tes reducidas en paso y aumentadas en bifurcación (A>C ; B>A; B>C)

130R
(B1)
REDUCING TEE (A x B x C)


SIZE	TYPE	CODE	DIMENSIONS (mm)						Weight (gr)
			a	b	c	z1	z2	z3	
3/8" - 1/4" - 3/8"	I	13001/5212	23	23	-	13	13	-	109
3/8" - 1/2" - 3/8"	II	13001/5232	26	26	-	16	13	-	80
3/8" - 3/4" - 3/8"	II	13001/5242	28	24	-	18	9	-	109
1/2" - 1/4" - 1/2"	I	13001/5313	24	24	-	11	14	-	82
1/2" - 3/8" - 3/8"	III	13001/5322	26	26	25	13	16	15	99
1/2" - 3/8" - 1/2"	I	13001/5323	26	26	-	13	16	-	106
1/2" - 1/2" - 3/8"	IV	13001/5332	28	28	26	15	15	16	108
1/2" - 3/4" - 3/8"	V	13001/5342	29	30	30	17	15	20	118
1/2" - 3/4" - 1/2"	II	13001/5343	31	30	-	18	15	-	159
1/2" - 1" - 1/2"	II	13001/5353	34	32	-	21	15	-	182
3/4" - 1/4" - 3/4"	I	13001/5414	26	27	-	11	17	-	130
3/4" - 3/8" - 1/2"	III	13001/5423	28	28	26	13	18	13	114
3/4" - 3/8" - 3/4"	I	13001/5424	28	28	-	13	18	-	139
3/4" - 1/2" - 3/8"	III	13001/5432	30	31	26	15	18	16	117
3/4" - 1/2" - 1/2"	III	13001/5433	30	31	28	15	18	15	122
3/4" - 1/2" - 3/4"	I	13001/5434	30	31	-	15	18	-	148
3/4" - 3/4" - 3/8"	IV	13001/5442	33	33	28	18	18	18	144
3/4" - 3/4" - 1/2"	IV	13001/5443	33	33	31	18	18	18	188
3/4" - 1" - 1/2"	V	13001/5453	36	35	34	21	18	21	201
3/4" - 1" - 3/4"	II	13001/5454	36	35	-	21	18	-	225
3/4" - 1 1/4" - 3/4"	II	13001/5464	41	36	-	26	17	-	251
1" - 1/4" - 1"	I	13001/5515	28	31	-	11	21	-	172
1" - 3/8" - 3/4"	III	13001/5524	30	32	28	13	22	13	181
1" - 3/8" - 1"	I	13001/5525	30	32	-	13	22	-	182
1" - 1/2" - 1/2"	III	13001/5533	32	34	28	15	21	15	221
1" - 1/2" - 3/4"	III	13001/5534	32	34	30	15	21	15	197
1" - 1/2" - 1"	I	13001/5535	32	34	-	15	21	-	196
1" - 3/4" - 1/2"	III	13001/5543	35	36	31	18	21	18	213
1" - 3/4" - 3/4"	III	13001/5544	35	36	33	18	21	18	184
1" - 3/4" - 1"	I	13001/5545	35	36	-	18	21	-	232
1" - 1" - 3/8"	IV	13001/5552	38	38	32	21	21	22	198
1" - 1" - 1/2"	IV	13001/5553	38	38	34	21	21	21	246
1" - 1" - 3/4"	IV	13001/5554	38	38	36	21	21	21	244
1" - 1 1/4" - 3/4"	V	13001/5564	42	40	41	25	21	26	316
1" - 1 1/4" - 1"	II	13001/5565	42	40	-	25	21	-	311
1" - 1 1/2" - 1"	II	13001/5575	46	42	-	29	23	-	338
1 1/4" - 3/8" - 1 1/4"	I	13001/5626	32	36	-	13	26	-	246
1 1/4" - 1/2" - 1"	III	13001/5635	34	38	32	15	25	15	240
1 1/4" - 1/2" - 1 1/4"	I	13001/5636	34	38	-	15	25	-	278
1 1/4" - 3/4" - 1/2"	III	13001/5643	36	39	36	17	24	23	236
1 1/4" - 3/4" - 3/4"	III	13001/5644	36	41	33	17	26	18	279
1 1/4" - 3/4" - 1"	III	13001/5645	36	41	35	17	26	18	287
1 1/4" - 3/4" - 1 1/4"	I	13001/5646	36	41	-	17	26	-	355
1 1/4" - 1" - 3/8"	III	13001/5652	41	43	30	22	26	20	258
1 1/4" - 1" - 1/2"	III	13001/5653	40	42	34	21	25	21	315
1 1/4" - 1" - 3/4"	III	13001/5654	40	42	36	21	25	21	300
1 1/4" - 1" - 1"	III	13001/5655	40	42	38	21	25	21	330
1 1/4" - 1" - 1 1/4"	I	13001/5656	40	42	-	21	25	-	405
1 1/4" - 1 1/4" - 1/2"	IV	13001/5663	45	45	38	26	26	25	322
1 1/4" - 1 1/4" - 3/4"	IV	13001/5664	45	45	41	26	26	26	380
1 1/4" - 1 1/4" - 1"	IV	13001/5665	45	45	42	26	26	25	371
1 1/4" - 1 1/2" - 1"	V	13001/5675	48	46	46	29	27	29	425
1 1/4" - 1 1/2" - 1 1/4"	II	13001/5676	48	46	-	29	27	-	440
1 1/4" - 2" - 1 1/4"	II	13001/5686	54	48	-	35	24	-	591
1 1/2" - 3/8" - 1 1/2"	I	13001/5727	35	40	-	16	30	-	339
1 1/2" - 1/2" - 1 1/4"	III	13001/5736	36	42	34	17	29	15	314
1 1/2" - 1/2" - 1 1/2"	I	13001/5737	36	42	-	17	29	-	362
1 1/2" - 3/4" - 1 1/4"	III	13001/5746	38	44	36	19	29	17	338
1 1/2" - 3/4" - 1 1/2"	I	13001/5747	38	44	-	19	29	-	419

130R
(B1)
REDUCING TEE (A x B x C)

I

II

III

IV

V

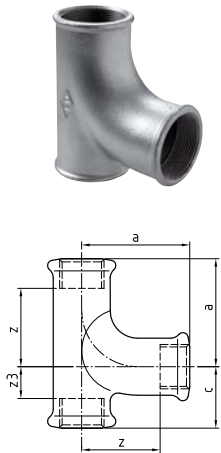
SIZE	TIPE	CODE	DIMENSIONS (mm)						Weight (gr)
			a	b	c	z1	z2	z3	
1 1/2" - 1" - 1"	III	13001/5755	42	46	38	23	29	21	360
1 1/2" - 1" - 1 1/4"	III	13001/5756	42	46	40	23	29	21	390
1 1/2" - 1" - 1 1/2"	I	13001/5757	42	46	-	23	29	-	472
1 1/2" - 1 1/4" - 1"	III	13001/5765	46	48	42	27	29	25	454
1 1/2" - 1 1/4" - 1 1/4"	III	13001/5766	46	48	45	27	29	26	490
1 1/2" - 1 1/4" - 1 1/2"	I	13001/5767	46	48	-	27	29	-	514
1 1/2" - 1 1/2" - 1 1/2"	IV	13001/5773	50	50	42	31	31	29	524
1 1/2" - 1 1/2" - 3/4"	IV	13001/5774	50	50	44	31	31	29	504
1 1/2" - 1 1/2" - 1"	IV	13001/5775	50	50	46	31	31	29	457
1 1/2" - 1 1/2" - 1 1/4"	IV	13001/5776	50	50	48	31	31	29	525
1 1/2" - 2" - 1 1/4"	V	13001/5786	56	54	56	37	30	37	621
1 1/2" - 2" - 1 1/2"	II	13001/5787	55	52	-	36	28	-	617
2" - 1/2" - 1 1/2"	III	13001/5837	38	48	38	14	35	19	519
2" - 1/2" - 2"	I	13001/5838	38	48	-	14	35	-	480
2" - 3/4" - 1 1/2"	III	13001/5847	40	50	38	16	35	19	504
2" - 3/4" - 2"	I	13001/5848	40	50	-	16	35	-	592
2" - 1" - 1 1/2"	III	13001/5857	44	52	42	20	35	23	536
2" - 1" - 2"	I	13001/5858	44	52	-	20	35	-	583
2" - 1 1/4" - 1"	III	13001/5865	52	55	52	28	36	35	579
2" - 1 1/4" - 1 1/4"	III	13001/5866	48	54	45	24	35	26	572
2" - 1 1/4" - 1 1/2"	III	13001/5867	48	54	46	24	35	27	560
2" - 1 1/4" - 2"	I	13001/5868	48	54	-	24	35	-	733
2" - 1 1/2" - 1"	III	13001/5875	55	57	54	31	38	37	618
2" - 1 1/2" - 1 1/2"	III	13001/5877	52	55	50	28	36	31	580
2" - 1 1/2" - 2"	II	13001/5878	52	55	-	28	36	-	809
2" - 2" - 1 1/2"	IV	13001/5883	58	58	48	34	34	35	666
2" - 2" - 3/4"	IV	13001/5884	58	58	50	34	34	35	748
2" - 2" - 1"	IV	13001/5885	58	58	52	34	34	35	766
2" - 2" - 1 1/4"	IV	13001/5886	58	58	54	34	34	35	824
2" - 2" - 1 1/2"	IV	13001/5887	58	58	55	34	34	36	749
2" - 2 1/2" - 2"	II	13001/5898	68	64	-	44	37	-	1189
2 1/2" - 1/2" - 2 1/2"	I	13001/5939	43	56	-	16	43	-	815
2 1/2" - 3/4" - 2 1/2"	I	13001/5949	45	58	-	18	43	-	770
2 1/2" - 1" - 2 1/2"	I	13001/5959	47	60	-	20	43	-	869
2 1/2" - 1 1/4" - 2 1/2"	I	13001/5969	52	62	-	25	43	-	951
2 1/2" - 1 1/2" - 2 1/2"	I	13001/5979	55	63	-	28	44	-	968
2 1/2" - 2" - 2"	III	13001/5988	67	72	62	40	48	38	1165
2 1/2" - 2" - 2 1/2"	I	13001/5989	61	66	-	34	42	-	1300
2 1/2" - 2 1/2" - 1 1/2"	IV	13001/5997	69	69	64	42	42	45	1500
2 1/2" - 2 1/2" - 2"	IV	13001/5998	73	73	68	46	46	34	1435
3" - 1/2" - 3"	I	13001/5A3A	46	63	-	15	50	-	1108
3" - 3/4" - 3"	I	13001/5A4A	48	66	-	18	51	-	1225
3" - 1" - 3"	I	13001/5A5A	51	67	-	21	50	-	1152
3" - 1 1/4" - 3"	I	13001/5A6A	55	70	-	25	51	-	1556
3" - 1 1/2" - 3"	I	13001/5A7A	58	71	-	28	52	-	1312
3" - 2" - 2"	III	13001/5A88	64	73	60	34	49	36	1480
3" - 2" - 3"	I	13001/5A8A	64	73	-	34	49	-	1687
3" - 2 1/2" - 3"	I	13001/5A9A	72	76	-	42	49	-	1738
3" - 3" - 2"	IV	13001/5AA8	78	79	72	48	49	48	1950
4" - 1/2" - 4"	I	13001/5C3C	60	76	-	24	63	-	1865
4" - 3/4" - 4"	I	13001/5C4C	62	78	-	26	64	-	1755
4" - 1" - 4"	I	13001/5C5C	56	81	-	20	64	-	1734
4" - 1 1/2" - 4"	I	13001/5C7C	64	84	-	28	65	-	2300
4" - 2" - 4"	I	13001/5C8C	70	86	-	34	62	-	2258
4" - 2 1/2" - 4"	I	13001/5C9C	77	89	-	41	62	-	2393
4" - 3" - 4"	I	13001/5CAC	84	92	-	48	62	-	2589
5" - 4" - 5"	I	13001/5DCD	100	110	-	60	72	-	4560

1/5 - 1= Black - 5= Galvanized

131

(E1)

PITCHER TEE



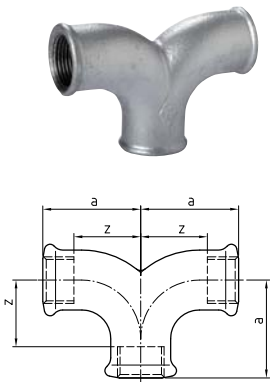
SIZE	CODE	DIMENSIONS (mm)				Weight (gr)	
		a	c	z	z3		
1/2"	13101/5003	45	24	32	11	241	
3/4"	13101/5004	50	28	35	13	332	
1"	13101/5005	63	33	46	16	457	
1 1/4"	13101/5006	76	40	57	21	685	
1 1/2"	13101/5007	85	43	66	24	1033	
2"	13101/5008	102	53	78	29	1400	
2 1/2"	13101/5009	115	62	88	35	2340	
3"	13101/500A	127	70	97	40	3755	
4"	13101/500C	165	87	129	51	6260	

1/5 - 1= Black - 5= Galvanized

132

(E2)

TWIN ELBOW

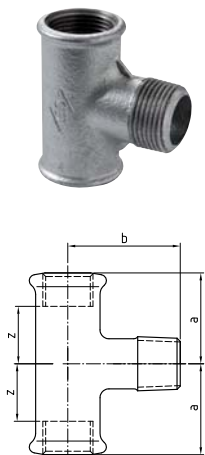


SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
1/2"	13201/5003	45	32	192	
3/4"	13201/5004	50	35	385	
1"	13201/5005	63	46	598	
1 1/4"	13201/5006	76	57	798	
1 1/2"	13201/5007	85	66	980	
2"	13201/5008	102	78	1920	

1/5 - 1= Black - 5= Galvanized

133

TEE

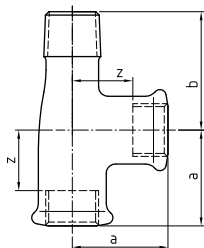


SIZE	CODE	DIMENSIONS (mm)			Weight (gr)	
		a	b	z		
3/8"	13301/5002	22	31	12	83	
1/2"	13301/5003	25	38	12	101	
3/4"	13301/5004	33	45	18	190	
1"	13301/5005	39	53	22	325	

1/5 - 1= Black - 5= Galvanized

134

TEE

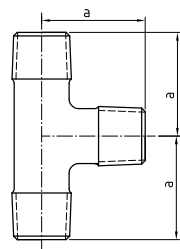


SIZE	CODE	DIMENSIONS (mm)			Weight (gr)
		a	b	z	
1/2"	13401/5003	27	37	14	106
3/4"	13401/5004	33	43	17	182
1"	13401/5005	37	50	20	298
1 1/4"	13401/5006	45	58	26	540
1 1/2"	13401/5007	50	65	31	587
2"	13401/5008	59	69	35	831

1/5 - 1= Black - 5= Galvanized

135

TEE

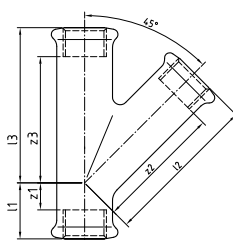


SIZE	CODE	DIMENSIONS (mm)	Weight (gr)
		a	
1/2"	13501/5003	37	128
3/4"	13501/5004	43	221
1"	13501/5005	48	344

1/5 - 1= Black - 5= Galvanized

165

TEE 45°



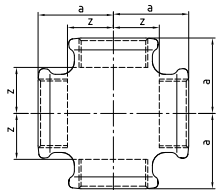
SIZE	CODE	DIMENSIONS (mm)						Weight (gr)
		l1	l2	l3	z1	z2	z3	
1/2"	16501/5003	23	54	54	10	41	41	213
3/4"	16501/5004	24	64	64	9	49	49	307
1"	16501/5005	28	77	77	11	60	60	447
1 1/4"	16501/5006	34	91	91	14	72	72	555
1 1/2"	16501/5007	34	98	98	15	79	79	992
2"	16501/5008	40	106	106	16	82	82	1255

1/5 - 1= Black - 5= Galvanized

180

(C1)

CROSS

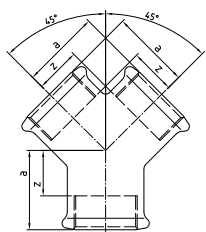


SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
1/4"	18001/5001	21	11	59	
3/8"	18001/5002	25	15	111	
1/2"	18001/5003	28	15	167	
3/4"	18001/5004	33	18	241	
1"	18001/5005	38	21	372	
1 1/4"	18001/5006	45	26	557	
1 1/2"	18001/5007	50	31	793	
2"	18001/5008	58	34	935	
2 1/2"	18001/5009	69	42	1455	
3"	18001/500A	78	48	2160	
4"	18001/500C	96	60	3980	

1/5 - 1= Black - 5= Galvanized

220

Y PIECE



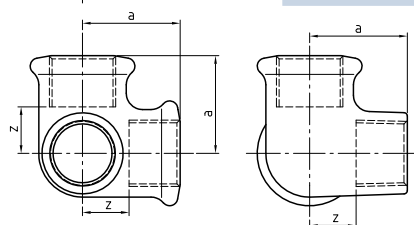
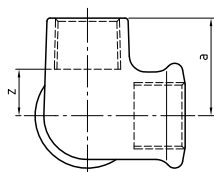
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
3/8"	22001/5002	24	14	100	
1/2"	22001/5003	27	14	124	
3/4"	22001/5004	33	18	189	
1"	22001/5005	40	23	290	

1/5 - 1= Black - 5= Galvanized

221

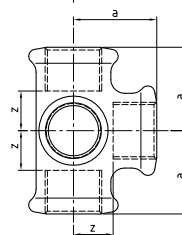
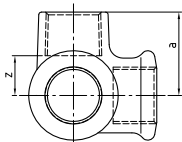
(Za1)

SIDE OUTLET ELBOW



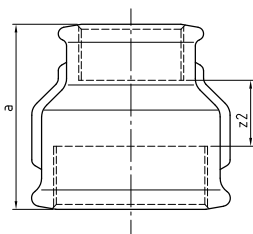
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
3/8"	22101/5002	25	15	102	
1/2"	22101/5003	28	15	92	
3/4"	22101/5004	33	18	158	
1"	22101/5005	38	21	228	
1 1/4"	22101/5006	45	26	485	
1 1/2"	22101/5007	50	31	575	
2"	22101/5008	58	34	826	

1/5 - 1= Black - 5= Galvanized

223
(Za2)
SIDE OUTLET TEE


SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
1/2"	22301/5003	28	15	164	
3/4"	22301/5004	33	18	185	
1"	22301/5005	38	21	430	

1/5 - 1= Black - 5= Galvanized

240
(M2)
REDUCING SOCKET


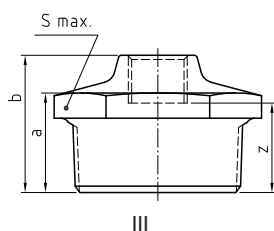
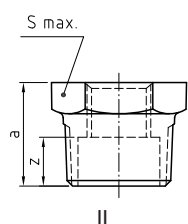
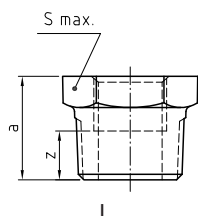
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z2		
1/4" - 1/8"	24011/5010	27	10	38	
3/8" - 1/8"	24011/5020	30	13	36	
3/8" - 1/4"	24011/5021	30	10	38	
1/2" - 1/4"	24001/5031	36	13	50	
1/2" - 3/8"	24001/5032	36	13	70	
3/4" - 1/4"	24001/5041	39	14	73	
3/4" - 3/8"	24001/5042	39	14	100	
3/4" - 1/2"	24001/5043	39	11	97	
1" - 3/8"	24001/5052	45	18	150	
1" - 1/2"	24001/5053	45	15	144	
1" - 3/4"	24001/5054	45	13	146	
1 1/4" - 3/8"	24001/5062	50	21	150	
1 1/4" - 1/2"	24001/5063	50	18	180	
1 1/4" - 3/4"	24001/5064	50	16	200	
1 1/4" - 1"	24001/5065	50	14	234	
1 1/2" - 1/2"	24001/5073	55	23	208	
1 1/2" - 3/4"	24001/5074	55	21	226	
1 1/2" - 1"	24001/5075	55	19	252	
1 1/2" - 1 1/4"	24001/5076	55	17	256	
2" - 1/2"	24001/5083	65	28	398	
2" - 3/4"	24001/5084	65	26	362	
2" - 1"	24001/5085	65	24	372	
2" - 1 1/4"	24001/5086	65	22	395	
2" - 1 1/2"	24001/5087	65	22	368	
2 1/2" - 1"	24001/5095	74	30	610	
2 1/2" - 1 1/4"	24001/5096	74	28	611	
2 1/2" - 1 1/2"	24001/5097	74	28	556	
2 1/2" - 2"	24001/5098	74	23	619	
3" - 1 1/4"	24001/50A6	80	31	1094	
3" - 1 1/2"	24001/50A7	80	31	736	
3" - 2"	24001/50A8	80	26	857	
3" - 2 1/2"	24001/50A9	80	23	860	
4" - 2"	24001/50C8	94	34	1311	
4" - 2 1/2"	24001/50C9	94	31	1385	
4" - 3"	24001/50CA	94	28	1387	

1/5 - 1= Black - 5= Galvanized

241

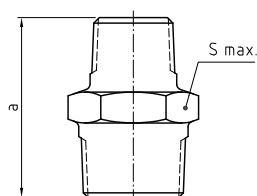
(N4)

REDUCING BUSH



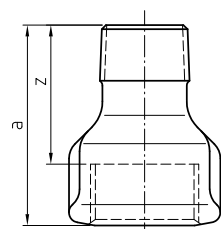
SIZE	TIPO	CODE	DIMENSIONS (mm)				Weight (gr)	
			a	b	z	S.máx.		
1/4" - 1/8"	I	24111/5010	20	-	13	17	15	
3/8" - 1/8"	II	24111/5020	20	-	13	19	22	
3/8" - 1/4"	I	24111/5021	20	-	10	19	19	
1/2" - 1/8"	II	24101/5030*	24	-	17	23	46	
1/2" - 1/4"	II	24101/5031	24	-	14	22	38	
1/2" - 3/8"	I	24101/5032	24	-	14	22	31	
3/4" - 1/4"	II	24101/5041	26	-	16	30	75	
3/4" - 3/8"	II	24101/5042	26	-	18	30	65	
3/4" - 1/2"	I	24101/5043	26	-	13	30	55	
1" - 1/4"	II	24101/5051	29	-	19	36	116	
1" - 3/8"	II	24101/5052	29	-	19	36	113	
1" - 1/2"	II	24101/5053	29	-	16	36	105	
1" - 3/4"	I	24101/5054	29	-	14	36	86	
1 1/4" - 3/8"	II	24101/5062	31	-	21	46	209	
1 1/4" - 1/2"	II	24101/5063	31	-	18	46	194	
1 1/4" - 3/4"	II	24101/5064	31	-	16	46	174	
1 1/4" - 1"	I	24101/5065	31	-	14	46	153	
1 1/2" - 3/8"	II	24101/5072	31	-	21	50	244	
1 1/2" - 1/2"	II	24101/5073	31	-	18	50	237	
1 1/2" - 3/4"	II	24101/5074	31	-	16	50	224	
1 1/2" - 1"	II	24101/5075	31	-	14	50	194	
1 1/2" - 1 1/4"	I	24101/5076	31	-	12	50	136	
2" - 1/2"	III	24101/5083	35	48	35	65	359	
2" - 3/4"	III	24101/5084	35	48	33	65	318	
2" - 1"	II	24101/5085	35	-	18	65	406	
2" - 1 1/4"	II	24101/5086	35	-	16	65	346	
2" - 1 1/2"	II	24101/5087	35	-	16	65	297	
2 1/2" - 1"	III	24101/5095	40	54	37	80	654	
2 1/2" - 1 1/4"	III	24101/5096	40	54	35	80	642	
2 1/2" - 1 1/2"	II	24101/5097	40	-	21	80	602	
2 1/2" - 2"	II	24101/5098	40	-	16	80	489	
3" - 1"	III	24101/50A5	44	59	42	95	936	
3" - 1 1/4"	III	24101/50A6	44	59	40	95	926	
3" - 1 1/2"	III	24101/50A7	44	59	40	95	872	
3" - 2"	II	24101/50A8	44	-	20	95	857	
3" - 2 1/2"	II	24101/50A9	44	-	17	95	608	
4" - 2"	III	24101/50C8	51	69	46	120	1639	
4" - 2 1/2"	III	24101/50C9	51	69	42	120	1574	
4" - 3"	II	24101/50CA	51	-	21	120	1347	
5" - 4"	II	24101/50DC	57	-	28	147	1996	
6" - 4"	III	24101/50EC	44	86	50	175	3695	
6" - 5"	II	24101/50ED	64	-	31	175	2976	

1/5 - 1= Black - 5= Galvanized

245
(N8)
REDUCING HEXAGON NIPPLE


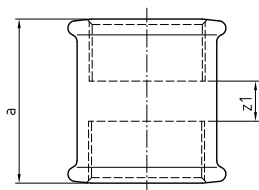
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	S.máx		
1/4" - 1/8"	24501/5010	35	17	27	
3/8" - 1/8"	24511/5020	34	19	32	
3/8" - 1/4"	24511/5021	38	19	36	
1/2" - 1/4"	24511/5031	44	22	47	
1/2" - 3/8"	24501/5032	44	22	52	
3/4" - 1/4"	24501/5041	43	30	93	
3/4" - 3/8"	24501/5042	47	30	83	
3/4" - 1/2"	24501/5043	47	30	84	
1" - 1/2"	24501/5053	53	36	138	
1" - 3/4"	24501/5054	53	36	149	
1 1/4" - 1/2"	24501/5063	57	46	213	
1 1/4" - 3/4"	24501/5064	57	46	226	
1 1/4" - 1"	24501/5065	57	46	222	
1 1/2" - 3/4"	24501/5074	59	50	230	
1 1/2" - 1"	24501/5075	59	50	264	
1 1/2" - 1 1/4"	24501/5076	59	50	278	
2" - 1"	24501/5085	68	65	447	
2" - 1 1/4"	24501/5086	68	65	462	
2" - 1 1/2"	24501/5087	68	65	529	
2 1/2" - 1 1/2"	24501/5097	75	80	752	
2 1/2" - 2"	24501/5098	75	80	646	
3" - 2"	24501/50A8	83	95	1110	
3" - 2 1/2"	24501/50A9	83	95	971	
4" - 3"	24501/50CA	93	120	1405	

1/5 - 1= Black - 5= Galvanized

246
(M4)
REDUCING SOCKET M/F


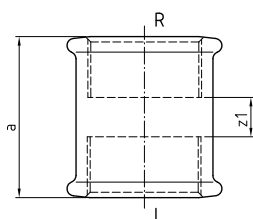
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
1/4" - 1/8"	24611/5010	32	22	28	
3/8" - 1/4"	24611/5021	35	25	46	
1/2" - 1/4"	24601/5031	43	30	48	
1/2" - 3/8"	24601/5032	43	30	71	
3/4" - 3/8"	24601/5042	48	33	73	
3/4" - 1/2"	24601/5043	48	33	100	
1" - 1/2"	24601/5053	55	38	131	
1" - 3/4"	24601/5054	55	38	123	
1 1/4" - 1/2"	24601/5063	60	41	189	
1 1/4" - 3/4"	24601/5064	60	41	188	
1 1/4" - 1"	24601/5065	60	41	219	
1 1/2" - 3/4"	24601/5074	60	41	233	
1 1/2" - 1"	24601/5075	63	44	271	
1 1/2" - 1 1/4"	24601/5076	63	44	276	
2" - 1"	24601/5085	70	46	345	
2" - 1 1/4"	24601/5086	70	46	406	
2" - 1 1/2"	24601/5087	70	46	380	
2 1/2" - 1 1/2"	24601/5097	83	56	790	
2 1/2" - 2"	24601/5098	80	53	658	
3" - 2"	24601/50A8	87	57	872	
3" - 2 1/2"	24601/50A9	91	61	937	

1/5 - 1= Black - 5= Galvanized

270**(M2)****SOCKET**

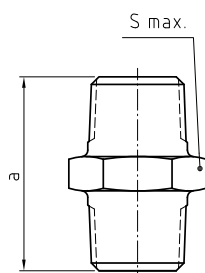
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z1		
1/8"	27011/5000	25	11	24	
1/4"	27011/5001	27	7	32	
3/8"	27001/5002	30	10	49	
1/2"	27001/5003	36	10	83	
3/4"	27001/5004	39	9	96	
1"	27001/5005	45	11	147	
1 1/4"	27001/5006	50	12	250	
1 1/2"	27001/5007	55	17	303	
2"	27001/5008	65	17	472	
2 1/2"	27001/5009	74	20	739	
3"	27001/500A	80	20	968	
4"	27001/500C	94	22	1761	
5"	27001/500D	109	29	2810	
6"	27001/500E	120	40	3530	

1/5 - 1= Black - 5= Galvanized

271**(M2 R-L)****RIGHT (R) / LEFT (L) SOCKET**

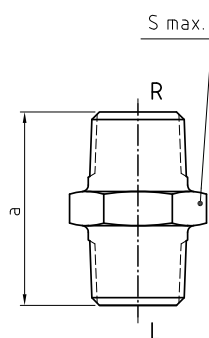
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z1		
3/8"	27101/5002	30	10	51	
1/2"	27101/5003	36	10	72	
3/4"	27101/5004	39	9	100	
1"	27101/5005	45	11	146	
1 1/4"	27101/5006	50	12	254	
1 1/2"	27101/5007	55	17	332	
2"	27101/5008	65	17	472	

1/5 - 1= Black - 5= Galvanized

280**(N8)****HEXAGON NIPPLE**

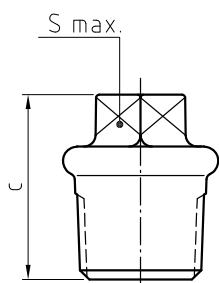
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	S máx		
1/8"	28011/5000	29	13	13	
1/4"	28011/5001	36	17	26	
3/8"	28001/5002	38	22	52	
1/2"	28001/5003	44	27	59	
3/4"	28001/5004	47	32	104	
1"	28001/5005	53	41	172	
1 1/4"	28001/5006	57	50	255	
1 1/2"	28001/5007	59	55	318	
2"	28001/5008	68	70	525	
2 1/2"	28001/5009	75	85	730	
3"	28001/500A	83	100	1053	
4"	28001/500C	95	130	2028	
5"	28001/500D	103	150	2520	
6"	28001/500E	110	180	2500	

1/5 - 1= Black - 5= Galvanized

281
(N8 R-L)
RIGHT (R) / LEFT (L) HEXAGON NIPPLE


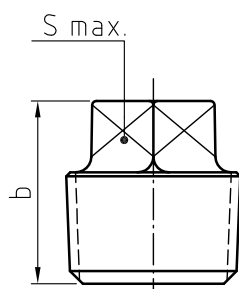
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	S.máx.		
3/8"	28101/5002	38	22	45	
1/2"	28101/5003	44	27	57	
3/4"	28101/5004	47	32	106	
1"	28101/5005	53	41	156	
1 1/4"	28101/5006	57	50	240	
1 1/2"	28101/5007	59	55	313	
2"	28101/5008	68	70	580	

1/5 - 1= Black - 5= Galvanized

290
(T9)
PLUG


SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		c	S.máx.		
1/8"	29011/5000	20	7	14	
1/4"	29011/5001	22	8	28	
3/8"	29001/5002	24	10	33	
1/2"	29001/5003	26	11	58	
3/4"	29001/5004	32	17	79	
1"	29001/5005	36	19	142	
1 1/4"	29001/5006	39	22	205	
1 1/2"	29001/5007	41	22	252	
2"	29001/5008	48	27	408	
2 1/2"	29001/5009	54	32	610	
3"	29001/500A	60	36	955	
4"	29001/500C	70	41	1669	

1/5 - 1= Black - 5= Galvanized

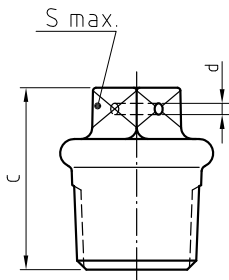
291
(T8)
PLAIN PLUG


SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		b	S.máx.		
1/8"	29111/5000	11	7	8	
1/4"	29111/5001	14	8	20	
3/8"	29101/5002	15	10	28	
1/2"	29101/5003	18	11	31	
3/4"	29101/5004	20	17	63	
1"	29101/5005	23	19	84	
1 1/4"	29101/5006	29	22	146	
1 1/2"	29101/5007	30	22	175	
2"	29101/5008	36	27	291	
2 1/2"	29101/5009	39	32	428	
3"	29101/500A	44	36	725	
4"	29101/500C	58	41	1450	

1/5 - 1= Black - 5= Galvanized

294

PLUG WITH HOLE IN SQUARE HEAD



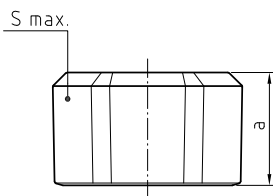
SIZE	CODE	DIMENSIONS (mm)			Weight (gr)
		c	S. máx.	d	
1/2"	29401/5003	32	11	4	40
3/4"	29401/5004	34	16	4	77
1"	29401/5005	37	19	5	109
1 1/4"	29401/5006	41	21	5	185
1 1/2"	29401/5007	46	20	5	217
2"	29401/5008	50	27	5	326

1/5 - 1= Black - 5= Galvanized

300

(T1)

CAP



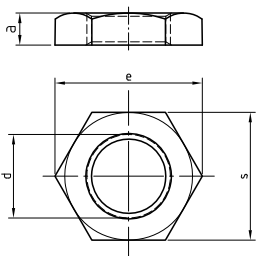
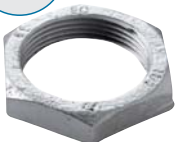
SIZE	CODE	DIMENSIONS (mm)		Weight (gr)
		a	S.máx.	
1/8"	30011/5000	13	15	16
1/4"	30011/5001	15	18	23
3/8"	30011/5002	17	22	37
1/2"	30001/5003	19	26	45
3/4"	30001/5004	22	32	78
1"	30001/5005	24	39	102
1 1/4"	30001/5006	27	48	156
1 1/2"	30001/5007	27	54	185
2"	30001/5008	32	66	326
2 1/2"	30001/5009	35	84	531
3"	30001/500A	38	96	942
4"	30001/500C	45	123	1841

1/5 - 1= Black - 5= Galvanized

310

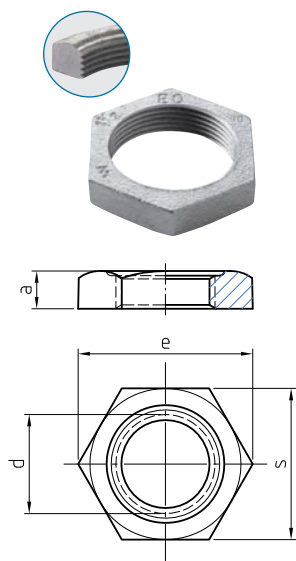
(P4)

BACKNUT



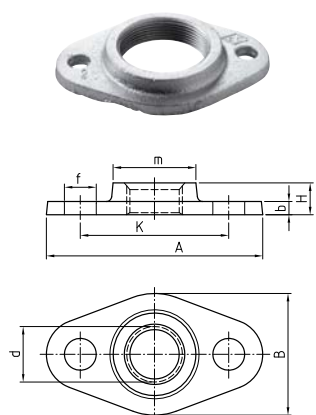
SIZE d	CODE	DIMENSIONS (mm)			Weight (gr)
		a	e aprox.	s	
1/4"	31011/5001	6	22	19	14
3/8"	31001/5002	8	28	24	20
1/2"	31001/5003	8	37	32	32
3/4"	31001/5004	9	42	36	38
1"	31001/5005	10	53	46	72
1 1/4"	31001/5006	11	62	54	95
1 1/2"	31001/5007	12	68	60	116
2"	31001/5008	13	86	75	199
2 1/2"	31001/5009	19	110	95	430
3"	31001/500A	22	120	105	538

1/5 - 1= Black - 5= Galvanized

312
(P4)
BACKNUT, RECESSED


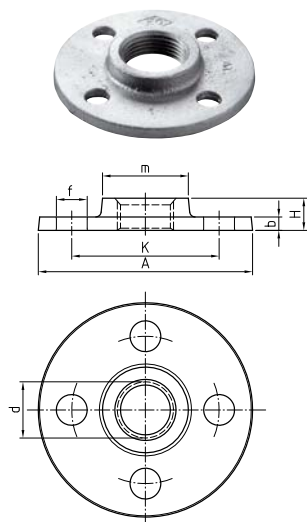
SIZE d	CODE	DIMENSIONS (mm)			Weight (gr)
		a	e aprox.	s	
1/4"	31211/5001	6	25	22	13
3/8"	31211/5002	7	30	27	21
1/2"	31201/5003	8	36,9	32	31
3/4"	31201/5004	9	41,6	36	37
1"	31201/5005	10	53,1	46	74
1 1/4"	31201/5006	11	63,5	55	92
1 1/2"	31201/5007	12	69,3	60	124
2"	31201/5008	13	86,5	75	222
2 1/2"	31201/5009	16	110,0	95	430
3"	31201/500A	19	126,0	109	620
4"	31201/500C	21	158,0	136	952

1/5 - 1= Black - 5= Galvanized

320
FLANGE


SIZE	CODE	DIMENSIONS (mm)								Weight (gr)
		d	m	K	A	B	H	b	f	
1/2"	32001/5003	Rp 1/2	32	55	80	45	12	5	11,5	101
3/4"	32001/5004	Rp 3/4	38	65	90	64	13	5	11,5	172
1"	32001/5005	Rp 1	46	75	100	72	14	6	11,5	237
1 1/4"	32001/5006	Rp 1 1/4	56	90	120	85	15	6	14	352
1 1/2"	32001/5007	Rp 1 1/2	63	100	130	95	16	7	14	446
2"	32001/5008	Rp 2	77	110	140	100	18	8	14	580
2 1/2"	32001/5009	Rp 2 1/2	92	130	160	118	20	9	14	800
3"	32001/500A	Rp 3	106	150	190	140	22	10	18	1155
4"	32001/500C	Rp 4	132	170	210	160	24	11	18	1503

1/5 - 1= Black - 5= Galvanized

321
FLANGE


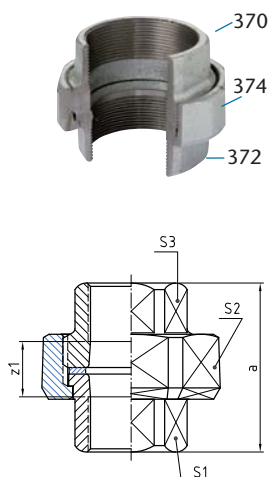
SIZE	CODE	DIMENSIONS (mm)							Weight	
		d	m	K	A	H	b	f	(gr)	
1/2"	32101/5003	Rp 1/2	32	55	80	12	5	11,5	191	
3/4"	32101/5004	Rp 3/4	38	65	90	13	5	11,5	245	
1"	32101/5005	Rp 1	46	75	100	14	6	11,5	355	
1 1/4"	32101/5006	Rp 1 1/4	56	90	120	15	6	14	558	
1 1/2"	32101/5007	Rp 1 1/2	63	100	130	16	7	14	670	
2"	32101/5008	Rp 2	77	110	140	18	8	14	850	
2 1/2"	32101/5009	Rp 2 1/2	93	130	160	20	9	14	1226	
3"	32101/500A	Rp 3	107	150	190	22	10	18	1812	
4"	32101/500C	Rp 4	133	170	210	24	11	18	2440	

1/5 - 1= Black - 5= Galvanized

330

(U1)

UNION FLAT SEAT F/F



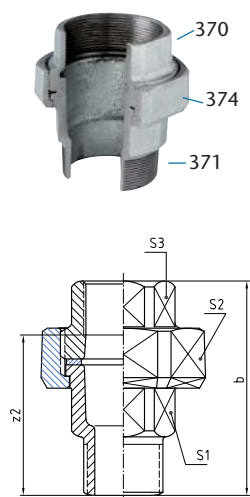
SIZE	374G	CODE	DIMENSIONS (mm)						Weight (gr)
			a	z1	s1	s2	s3	s2 máx	
1/2"	1 1/8	33001/5003	48	22	26	44	26	46	213
3/4 "	1 1/4	33001/5004	52	22	32	48	32	50	291
1"	1 1/2	33001/5005	58	24	38	54	38	55	363
1 1/4 "	2	33001/5006	65	27	48	68	48	70	614
1 1/2 "	2 1/4	33001/5007	70	32	54	74	54	75	729
2"	2 3/4	33001/5008	78	30	66	89	66	90	1071
2 1/2 "	3 1/2	33001/5009	85	31	86	110	86	110	1899
3"	4	33001/500A	95	36	95	130	95	130	2528
4"	5	33001/500C	110	38	121	150	121	150	3436

1/5 - 1= Black - 5= Galvanized

331

(U2)

UNION FLAT SEAT M/F



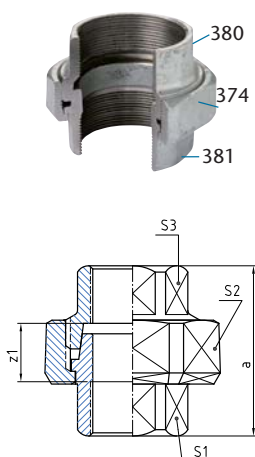
SIZE	374G	CODE	DIMENSIONS (mm)						Weight (gr)
			b	z2	s1	s2	s3	s2 máx	
3/8"	3/4	33101/5001	58	48	22	32	22	36	118
1/2"	1 1/8	33101/5002	66	53	26	44	26	46	235
3/4"	1 1/4	33101/5003	72	57	32	48	32	50	332
1"	1 1/2	33101/5004	80	63	38	54	38	55	438
1 1/4"	2	33101/5005	90	71	48	68	48	70	718
1 1/2"	2 1/4	33101/5006	95	76	54	74	54	75	889
2"	2 3/4	33101/5007	106	82	66	89	66	90	1333
2 1/2"	3 1/2	33101/5008	116	89	86	110	86	110	2268
3"	4	33101/5009	127	97	95	130	95	130	3071

1/5 - 1= Black - 5= Galvanized

340

(U11)

UNION TAPER SEAT F/F



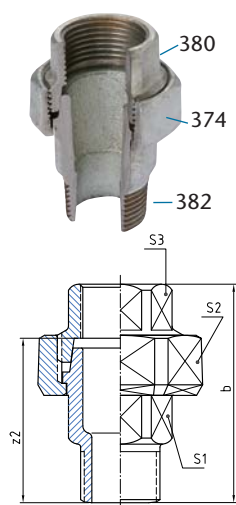
SIZE	374G	CODE	DIMENSIONS (mm)						Weight (gr)
			a	z1	s1	s2	s3	s2 máx	
1/8"	1/2	34001/5000	38	24	15	26	15	26	69
1/4"	3/4	34001/5001	42	22	17	31	17	32	104
3/8"	7/8	34001/5002	45	25	22	35	22	36	146
1/2"	1 1/8	34001/5003	48	22	26	44	26	46	226
3/4"	1 1/4	34001/5004	52	22	32	48	32	50	293
1"	1 1/2	34001/5005	58	24	38	54	38	55	364
1 1/4"	2	34001/5006	65	27	46	68	46	70	625
1 1/2"	2 1/4	34001/5007	70	32	53	74	53	75	749
2"	2 3/4	34001/5008	78	30	66	89	66	90	1116
2 1/2"	3 1/2	34001/5009	85	31	83	110	83	110	1926
3"	4	34001/500A	95	36	95	130	95	130	2594
4"	5	34001/500C	110	38	121	150	121	150	3617

1/5 - 1= Black - 5= Galvanized

341

(U12)

UNION TAPER SEAT M/F

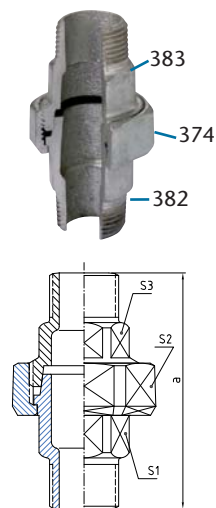


SIZE	374G	CODE	DIMENSIONS (mm)						Weight (gr)
			b	z2	s1	s2	s3	s2 máx	
1/4"	3/4	34101/5001	55	45	17	31	17	32	117
3/8"	7/8	34101/5002	58	48	22	35	22	36	156
1/2"	1 1/8	34101/5003	66	53	26	44	26	46	246
3/4"	1 1/4	34101/5004	72	57	32	48	32	50	332
1"	1 1/2	34101/5005	80	63	38	54	38	55	449
1 1/4"	2	34101/5006	90	71	46	68	46	70	703
1 1/2"	2 1/4	34101/5007	95	76	53	74	53	75	911
2"	2 3/4	34101/5008	106	82	66	89	66	90	1338
2 1/2"	3 1/2	34101/5009	118	91	83	110	83	110	2248
3"	4	34101/500A	130	100	95	130	95	130	3120
4"	5	34101/500C	152	112	121	150	121	150	5094

1/5 - 1= Black - 5= Galvanized

344

UNION TAPER SEAT M/M

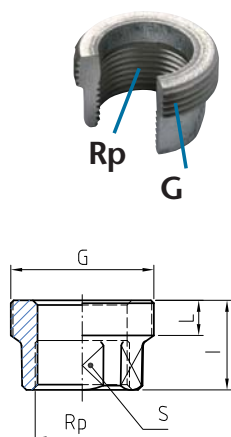


SIZE	374G	CODE	DIMENSIONS (mm)				Weight (gr)
			a	s1	s2	s3	
1/4"	5/8	34401/5001	69	18	28	15	109
3/8"	3/4	34401/5002	75	22	32	20	146
1/2"	1	34401/5003	85	26	39	23	256
3/4"	1 1/4	34401/5004	93	32	48	30	381
1"	1 1/2	34401/5005	103	38	55	36	555
1 1/4"	2	34401/5006	114	48	67	48	845
1 1/2"	2 1/4	34401/5007	123	54	74	54	1063
2"	2 3/4	34401/5008	136	66	90	67	1575

1/5 - 1= Black - 5= Galvanized

370

UNION BUSH

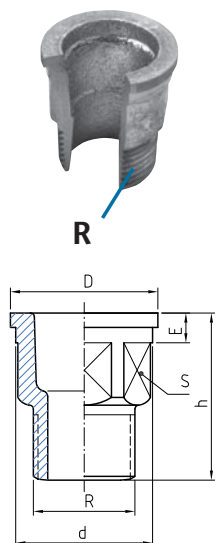


UNION MEASUREMENT	Rp	CODE	G	DIMENSIONS (mm)			tightening	Weight (gr)
				I	L	S		
1/2"	1/2	37001/5003	1 1/8	24	8,3	26	hexagon	66
3/4"	3/4	37001/5004	1 1/4	26	9	32	hexagon	98
1"	1	37001/5005	1 1/2	29	12	38	hexagon	132
1 1/4"	1 1/4	37001/5006	2	31	10,3	48	hexagon	204
1 1/2"	1 1/2	37001/5007	2 1/4	34	11	54	hexagon	265
2"	2	37001/5008	2 3/4	40	14,5	66	hexagon	420
2 1/2"	2 1/2	37001/5009	3 1/2	45	14,5	86	hexagon	764
3"	3	37001/500A	4	49	15,5	95	hexagon	917
4"	4	37001/500C	5	57	19	121	octagon	1314

1/5 - 1= Black - 5= Galvanized

371

MALE UNION END

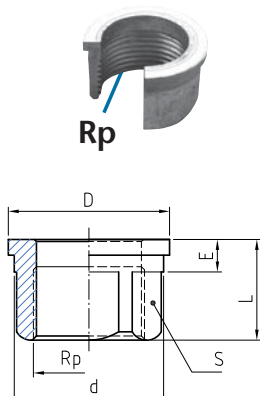


SIZE UNIÓN	R	CODE	374G	DIMENSIONS (mm)					tightening	Weight (gr)
				h	E	d	D	S		
1/2"	1/2	37101/5003	1 1/8	40	7,5	31,60	34,3	26	hexagon	82
3/4"	3/4	37101/5004	1 1/4	44	7,8	35,60	38,4	32	hexagon	117
1"	1	37101/5005	1 1/2	49	9,0	40,90	44,2	38	hexagon	176
1 1/4"	1 1/4	37101/5006	2	56	10,3	52,20	56,0	48	hexagon	270
1 1/2"	1 1/2	37101/5007	2 1/4	58	10,5	58,10	62,0	54	hexagon	380
2"	2	37101/5008	2 3/4	65	10,8	73,00	77,8	66	hexagon	581
2 1/2"	2 1/2	37101/5009	3 1/2	70	11,5	90,00	96,0	86	hexagon	892
3"	3	37101/500A	4	75	11,5	104,00	109,0	95	hexagon	1249

1/5 - 1= Black - 5= Galvanized

372

FEMALE UNION END



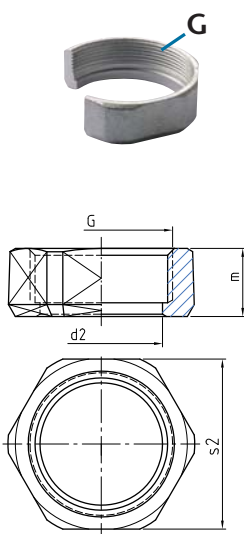
SIZE UNIÓN	Rp	CODE	374G	DIMENSIONS (mm)					tightening	Weight (gr)
				L	d	D	E	S		
1/2"	1/2	37201/5003	1 1/8	22,00	31,60	34,3	7,5	26	hexagon	60
3/4"	3/4	37201/5004	1 1/4	24,00	35,60	38,4	7,8	32	hexagon	76
1"	1	37201/5005	1 1/2	26,50	40,90	44,2	9,0	38	hexagon	101
1 1/4"	1 1/4	37201/5006	2	31,00	52,20	56,0	10,3	48	hexagon	166
1 1/2"	1 1/2	37201/5007	2 1/4	33,00	58,10	62,0	10,5	54	hexagon	220
2"	2	37201/5008	2 3/4	34,00	73,00	77,8	10,8	66	hexagon	319
2 1/2"	2 1/2	37201/5009	3 1/2	38,00	90,00	96,0	11,5	86	hexagon	528
3"	3	37201/500A	4	43,00	104,00	109,0	11,5	95	hexagon	706

1/5 - 1= Black - 5= Galvanized

374

(P1)

UNION NUT

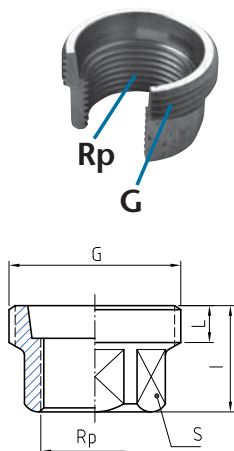


SIZE UNIÓN	CODE	G	DIMENSIONS (mm)				tightening	Weight (gr)
			m	d2	s2	s2 máx		
1/2"	37401/5003	1 1/8	19	32,2	44	46	hexagon	87
3/4"	37401/5004	1 1/4	20	36,2	48	50	hexagon	117
1"	37401/5005	1 1/2	22	41,8	55	55	hexagon	130
1 1/4"	37401/5006	2	24	52,9	70	68	hexagon	244
1 1/2"	37401/5007	2 1/4	25	59,1	73	74	hexagon	244
2"	37401/5008	2 3/4	27	73,9	89	90	hexagon	332
2 1/2"	37401/5009	3 1/2	30	90,5	110	110	hexagon	596
3"	37401/500A	4	31	104,5	126	130	hexagon	905
4"	37401/500C	5	36	129,5	150	150	hexagon	1118

1/5 - 1= Black - 5= Galvanized

380

FEMALE TAPER UNION

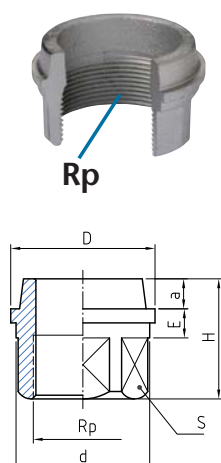


SIZE UNIÓN	Rp	G	DIMENSIONS (mm)			tightening	
			I	L	S		
1/8"	1/8	1/2	19,00	9,50	15	hexagon	
1/4"	1/4	3/4	19,00	7,80	17	hexagon	
3/8"	3/8	7/8	24,00	7,80	22	hexagon	
1/2"	1/2	1 1/8	24,00	8,30	26	hexagon	
3/4"	3/4	1 1/4	26,00	9,00	32	hexagon	
1"	1	1 1/2	29,00	11,00	38	hexagon	
1 1/4"	1 1/4	2	31,00	11,00	46	hexagon	
1 1/2"	1 1/2	2 1/4	34,50	11,00	53	hexagon	
2"	2	2 3/4	40,00	14,50	66	hexagon	
2 1/2"	2 1/2	3 1/2	45,00	14,50	83	hexagon	
3"	3	4	49,00	15,50	95	hexagon	
4"	4	5	57,50	19,00	121	octagon	

1/5 - 1= Black - 5= Galvanized

381

FEMALE TAPER END

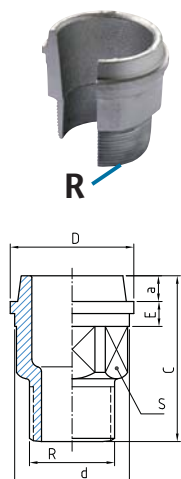


SIZE UNIÓN	Rp	374G	DIMENSIONS (mm)						tightening
			H	E	a	d	D	S	
1/8"	1/8	1/2	24,00	10,5	6,50	15,80	18,20	15	hexagon
1/4"	1/4	3/4	23,00	7,00	6,00	20,80	23,50	17	hexagon
3/8"	3/8	7/8	26,00	7,00	7,00	24,70	27,60	22	hexagon
1/2"	1/2	1 1/8	29,00	7,50	7,00	31,60	34,30	26	hexagon
3/4"	3/4	1 1/4	32,00	7,80	8,00	35,60	38,40	32	hexagon
1"	1	1 1/2	36,00	9,00	9,50	40,90	44,20	38	hexagon
1 1/4"	1 1/4	2	41,50	10,30	10,00	52,20	56,00	46	hexagon
1 1/2"	1 1/2	2 1/4	44,00	10,50	11,00	58,10	62,00	53	hexagon
2"	2	2 3/4	46,00	10,80	12,00	73,00	77,80	66	hexagon
2 1/2"	2 1/2	3 1/2	50,00	11,50	12,00	90,00	96,00	83	hexagon
3"	3	4	55,50	11,50	12,00	104,00	109,00	95	hexagon
4"	4	5	65,00	12,50	14,00	128,00	134,00	121	hexagon

1/5 - 1= Black - 5= Galvanized

382

MALE TAPER END

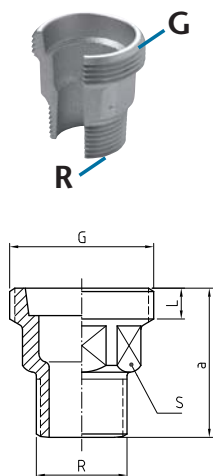


SIZE UNIÓN	R	374G	DIMENSIONS (mm)						tightening
			C	E	a	d	D	S	
1/4"	1/4	3/4	33,0	7,00	6,00	20,80	23,50	17	hexagon
3/8"	3/8	7/8	39,0	7,00	7,00	24,70	27,60	22	hexagon
1/2"	1/2	1 1/8	47,0	7,50	7,00	31,60	34,30	26	hexagon
3/4"	3/4	1 1/4	51,5	7,80	8,00	35,60	38,40	32	hexagon
1"	1	1 1/2	59,0	9,00	9,50	40,90	44,20	38	hexagon
1 1/4"	1 1/4	2	66,5	10,30	10,00	52,20	56,00	46	hexagon
1 1/2"	1 1/2	2 1/4	67,5	10,50	11,00	58,10	62,00	53	hexagon
2"	2	2 3/4	77,0	10,80	12,00	73,00	77,80	66	hexagon

1/5 - 1= Black - 5= Galvanized

383

MALE TAPER UNION

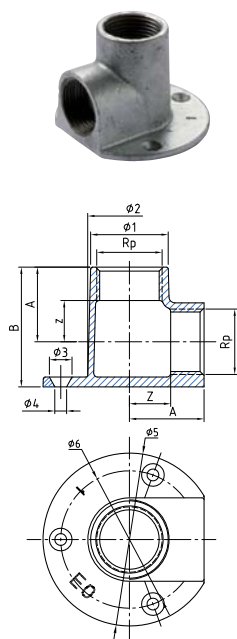


SIZE UNIÓN	R	G	DIMENSIONS (mm)			tightening	
			a	L	S		
1/4"	1/4	5/8	35	7,80	19,00	hexagon	
3/8"	3/8	3/4	39	7,80	22,00	hexagon	
1/2"	1/2	1	44	8,30	26,00	hexagon	
3/4"	3/4	1 1/4	48	9,00	32,00	hexagon	
1"	1	1 1/2	54	11,00	38,00	hexagon	
1 1/4"	1 1/4	2	58	11,00	48,00	hexagon	
1 1/2"	1 1/2	2 1/4	61	11,00	54,00	hexagon	
2"	2	2 3/4	71	14,50	66,00	hexagon	

1/5 - 1= Black - 5= Galvanized

471

BRACKET ELBOW

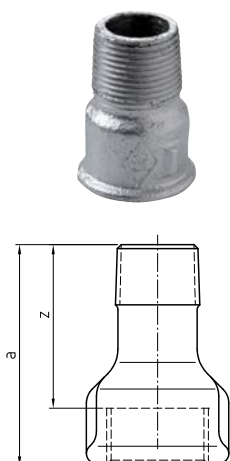


SIZE	CODE	DIMENSIONS (mm)										Weight (gr)
		Rp	A	B	z	Φ1	Φ2	Φ3	Φ4	Φ5	Φ6	
1/2"	47101/5003	1/2	28	46	15	27	29	10	5	60	46	185
3/4"	47101/5004	3/4	33	53	18	34	37	11	6	74	58	322
1"	47101/5005	1	38	61	21	40	43	12	6	88	70	448

1/5 - 1= Black - 5= Galvanized

526

EXTENSION TUBE

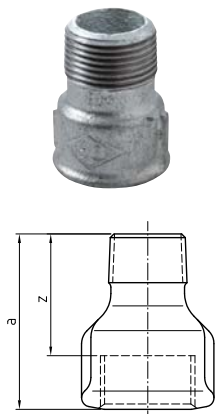


SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
3/8" - 30	52601/5302	30	20	36	
1/2" - 30	52601/5303	30	19	42	
3/8" - 40	52601/5402	40	30	42	
1/2" - 40	52601/5403	40	27	50	
3/4" - 40	52601/5404	40	25	87	
1/2" - 50	52601/5503	50	37	87	
3/4" - 50	52601/5504	50	35	101	

1/5 - 1= Black - 5= Galvanized

529A (M4)

EXTENSION TUBE

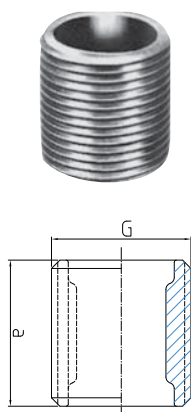


SIZE	CODE	DIMENSIONS (mm)		Weight (gr)	
		a	z		
3/8"	529A01/5002	35	25	45	
1/2"	529A01/5003	43	30	71	
3/4"	529A01/5004	48	33	98	
1"	529A01/5005	55	38	153	
1 1/4"	529A01/5006	60	41	230	
1 1/2"	529A01/5007	63	44	280	
2"	529A01/5008	70	46	464	

1/5 - 1= Black - 5= Galvanized

531

INTERNAL NIPPLE

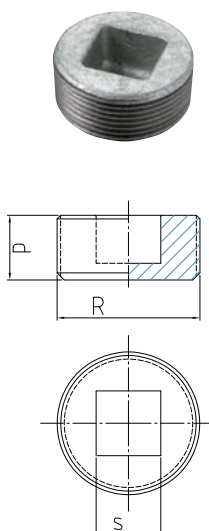


SIZE G	CODE	DIMENSIONS (mm)		Weight (gr)	
		a			
1/8"	53111/5000	19		9	
1/4"	53111/5001	17		11	
3/8"	53101/5002	23		36	
1/2"	53101/5003	25		28	
3/4"	53101/5004	30		45	
1"	53101/5005	35		72	
1 1/4"	53101/5006	40		109	
1 1/2"	53101/5007	45		191	
2"	53101/5008	50		280	
2 1/2"	53101/5009	56		410	
3"	53101/500A	69		690	
4"	53101/500C	82		842	

1/5 - 1= Black - 5= Galvanized

596 (T11)

PLUG SQUARE INSIDE



SIZE R	CODE	DIMENSIONS (mm)		Weight (gr)	
		d	S		
3/8"	59601/5002	10	8	12	
1/2"	59601/5003	15	10	26	
3/4"	59601/5004	17	12	48	
1"	59601/5005	19	16	82	
1 1/4"	59601/5006	22	22	140	
1 1/2"	59601/5007	22	22	202	
2"	59601/5008	27	27	380	

1/5 - 1= Black - 5= Galvanized

4.1. BASIC ASSEMBLY

The basic operations for the joining of threaded fittings and steel pipes are:

- Secure the pipe: the pipe must be secured at every moment in order to avoid deformations in the tightening (pipes that are very long will require additional support)
- Cut of the pipe: this must be made perpendicular to the axis of the pipe.
- Threading of the pipe. The following have to be taken into account:
 - The thread (male) will be initiated in an extreme perpendicular to the axis.
 - The oil to be used is appropriate :
 - Good lubrication and refrigeration capabilities.
 - Good solubility in water. (in order to be removed) .
 - It is not contaminating.
 - Centring the threads.
 - The diameter of the threads is adequate, for which the use of standardised calibrated alloys is necessary. (EN 10226-3)
- Curvature of the pipe. The following aspects need to be taken into account:
 - Steel pipes with a DN superior to 50 (2 inches) should not be bent.
 - The curving process must always be carried out in cold temperatures.
 - In soldered pipes, the soldering must be in the upper part so that its reaction can be observed.
 - The length of the starting straight pipe is adequate.
- Assembling the joint: to ensure the sealing of the joint, the following aspects need to be taken into account:
 - Remove any shavings or foreign bodies in the interior and exterior of the pipe and in the fitting.
 - Assure that both fittings are free from foreign bodies (shavings, dirt, dry oil,..).
 - Apply the liquid or solid sealing material (Teflon, hemp, hemp paint, etc.) to the male thread in a homogenous and thorough way (if it is a solid, it should follow the direction of the threads).
 - During the manual assembly, assure that the longitudinal axes are aligned adequately.
- Tightening of the joint: the following aspects need to be taken into account:
 - Apply the appropriate torque.

DIAMETER		APPROXIMATE TURQUE (Nm)
3/8	DN 10	65
1/2	DN 15	65
3/4	DN 20	125
1	DN 25	125
1 1/4	DN 32	185
1 1/2	DN 40	185
2	DN 50	245
2 1/2	DN 65	245
3	DN 80	245
4	DN 100	300

- After the final tightening, remove those unions where the washout thread has been used.



4.2. LINEAR EXPANSION

The temperature changes in the fluid that circulates through the pipe have an impact on the length of this as well as all on its elements (fittings, valves, clamps and alignment,...)

The calculation of the length increase (ΔL) associated with the increase in the temperature (ΔT) is given by the expression:

$$\Delta L = \alpha L_o \Delta T$$

ΔL = increase in the length of the pipe (mm)

L_o = initial length of the pipe (mm)

ΔT = increase in the temperature ($^{\circ}\text{C}$)

α = linear expansion coefficient of steel ($^{\circ}\text{C}^{-1}$) whose value is 1.2×10^{-5} (between 0°C and 100°C)

LINEAR EXPANSION IN STEEL PIPES											
Initial length pipe (m)	Increase in temperature ΔT ($^{\circ}\text{C}$)										
	1	5	10	15	20	25	30	35	40	45	50
	Increase in length of the pipe ΔL (mm)										
1	0,012	0,060	0,120	0,180	0,240	0,300	0,360	0,420	0,480	0,540	0,600
2	0,024	0,120	0,240	0,360	0,480	0,600	0,720	0,840	0,960	1,080	1,200
3	0,036	0,180	0,360	0,540	0,720	0,900	1,080	1,260	1,440	1,620	1,800
4	0,048	0,240	0,480	0,720	0,960	1,200	1,440	1,680	1,920	2,160	2,400
5	0,060	0,300	0,600	0,900	1,200	1,500	1,800	2,100	2,400	2,700	3,000
6	0,072	0,360	0,720	1,080	1,440	1,800	2,160	2,520	2,880	3,240	3,600
7	0,084	0,420	0,840	1,260	1,680	2,100	2,520	2,940	3,360	3,780	4,200
8	0,096	0,480	0,960	1,440	1,920	2,400	2,880	3,360	3,840	4,320	4,800
9	0,108	0,540	1,080	1,620	2,160	2,700	3,240	3,780	4,320	4,860	5,400
10	0,120	0,600	1,200	1,800	2,400	3,000	3,600	4,200	4,800	5,400	6,000

4.3. ASSEMBLY LENGTH (Z dimension)

In the joints between pipes and fittings, the **assembly length or Dimension "Z"** is defined as the distance between the pipe end and the axis of the fitting (diagrams 1 and 2) or the distance between the ends of two pipes joined to a fitting (diagram 3) and is regulated so as to guide and help with the installation.

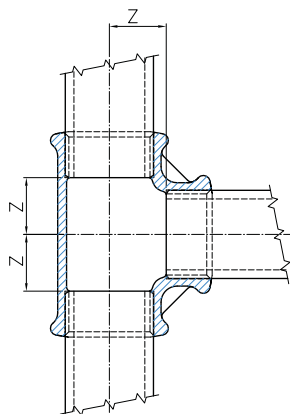


Figure 1

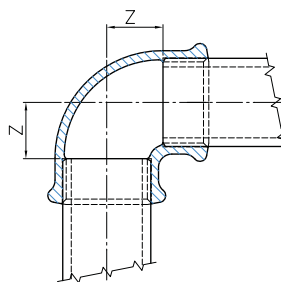


Figure 2

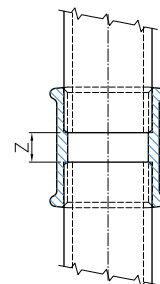


Figure 3

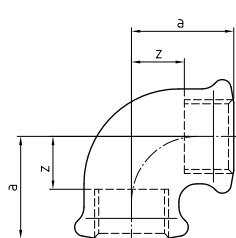
In order for this to be calculated, we will use the concepts of length coupling, distance between faces and axes, and parameters whose values will have been established as an EN 10242 standard of the product.

In this way the “z” dimension can be calculated as:

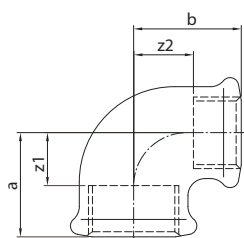
$$Z = (\text{distance pipe-pipe or distance pipe-axis}) - \text{length of the coupling}$$

Here are some examples :

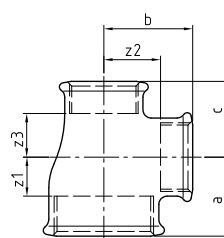
- 1 inch A1 Elbow (Ref.90)
 - $z = a - \text{coupling length} = 38 - 17 = 21$
- 1 3/4 inch A1 Reducing Elbow (Ref. 90)
 - $z1 = a - \text{coupling length} = 35 - 17 = 18$ (1 inch mouth)
 - $z2 = b - \text{coupling length} = 36 - 15 = 21$ (3/4 inch mouth)
- 1 1/2 1/2 inch B1 Tee (Ref. 130)
 - $z1 = a - \text{coupling length} = 32 - 17 = 15$ (1 inch mouth)
 - $z2 = b - \text{coupling length} = 34 - 13 = 21$ (1/2 inch mouth)
 - $z3 = c - \text{coupling length} = 28 - 13 = 15$ (1/2 inch mouth)
- 1/2 inch M2 socket (Ref. 270)
 - $z = a - 2 * (\text{coupling length}) = 36 - 2 * (13) = 10$ (1/2 inch mouth)



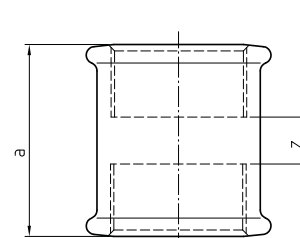
A1 (90)



A1 (90R)



B1 (130R)



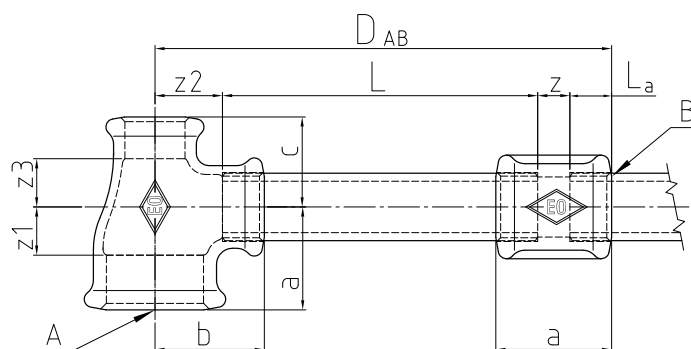
M2 (270)

LENGTH OF COUPLING ACCORDING TO EN 10242														
Designation of each thread	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
Length of coupling (mm)	7	10	10	13	15	17	19	19	24	27	30	36	40	40

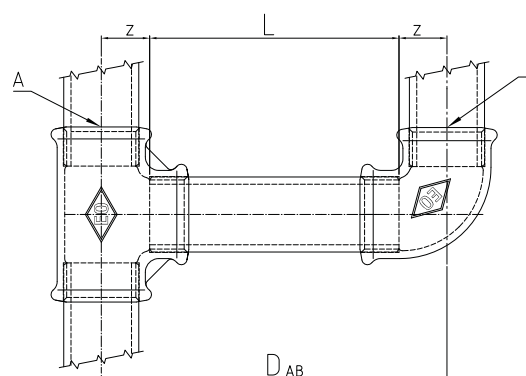
Nota: los valores de las cotas a, b, c, etc se especifican en las tablas dimensionales del capítulo 3 (DIMENSIONS)

By using the aforementioned concepts, the length of the pipes needed can be calculated before the installation.

Hence, the value of L (**length of the pipe**) to perform the union of the fittings between two known points A and B situated (for example) 1 meter apart, can be calculated as follows:



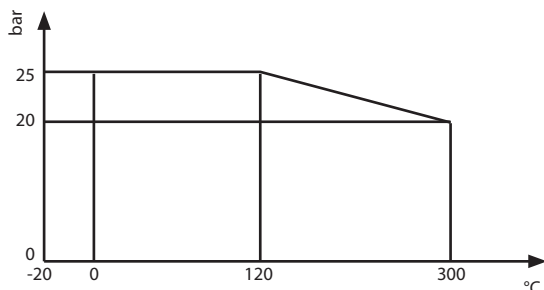
$$\begin{aligned}
 &130-1-1/2-1/2 (A) \text{ --- } (B) 270-1/2 \\
 &L = \text{Distance (A-B)} - (Z_2 + Z_3 + L_a) \\
 &L = 1000 - (21 + 10 + 13) = 956 \text{ mm}
 \end{aligned}$$



$$\begin{aligned}
 &130-1 (A) \text{ --- } (B) 90-1 \\
 &L = \text{Distance (A-B)} - (Z_{130} + Z_{90}) \\
 &L = 1000 - (21 + 21) = 958 \text{ mm}
 \end{aligned}$$

The fittings, for general use, are ideal for transmission of fluids and gases up to the following limits of pressure and temperature. By design, they are capable of resisting the tensions involved during the threading operations of other elements of conduction:

a) normal use



Working temperature (°C)	Máxima presión de trabajo admisible (bar)
-20 to 120	25
between 120 y 300	Interpolated values
300	20

b) special uses

ATUSA provides fittings which are apt for working under conditions which exceed the limit specified for normal use.

These special types of fittings are used in fire protection systems with inert gases which operate under high pressures. For the provision of these fittings, a type of test has to be undertaken to satisfy the **Vds 2093 07.83 regulation**. (These pieces are provided with a special marking and can be specially certified).

BASIC SECTORS OF USE

As regards their use, the fittings provide great versatility. So, sectors such as industry, agriculture, civil engineering and construction, have been using our products for a long time.

Examples of installations (of conduction):

- Heating and sanitation
- Air conditioning
- Fire protection
- Agricultural watering systems
- General conduction of water and gases
- Gas distribution networks and connections
- Boilers and industrial fridges
- Capital goods (machine tools, ovens,...)

Classical, but not so technical, examples are their use in railings, scaffolding, land enclosure, decoration, etc.

DIFFERENTIAL CHARACTERISTICS

High mechanical resistance

As the following tables show, the malleable cast iron fittings and steel pipes offer high mechanical resistance values when compared with other materials, demonstrating much better behaviour when faced with high pressure requirements, expansion tension, pressure overload due to fluid hammer, etc.

	MATERIAL				
	Galvanized steel	Cast iron	Copper	Hard PVC	Thermoresisten PVC
Resistencia Tracción (Kg/cm²)	5000	4000	2470	530	550
Alargamiento (%)	22	5	53	100	30
Dureza Brinell (HB)	140	210	64	-	-

Comparative example (same elements)		
	Allowable pressure (bar)	Observation
Steel tube DN20 medium series	258	Para el cálculo se ha utilizado el mismo coeficiente de seguridad y la resistencia reflejada en la tabla anterior
Steel tube DN20 heavy series	336	
Malleable elbow 3/4"	330	
Copper tube 20x22	50	
PVC hard tube 21x25	20	
Thermoresistant tube 21x25	21	

High resistance to fire

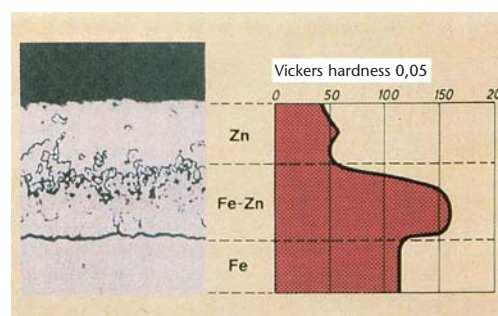
As the following table shows, the malleable cast iron fittings and steel pipes offer low expansion coefficients in comparison with other materials, which means they yield fewer tension problems and deformations. Moreover, a high melting point, much higher than other materials, allows the mechanical properties to be maintained at much higher temperatures, which means that these fittings are much more appropriate than others for fire protection systems, security conductions, etc.

	MATERIAL		
	Steel / Casting	Copper	PVC
Dilation Coef x 10 ⁻⁶ (°C ⁻¹)	11,6	17,6 (+52%)	70 (+503%)
Melting point (°C)	1540	1078 (-30%)	aprox 120 (-92%)

High resistance to corrosion – abrasion

The hot dip galvanized coating (external Zn + internal Fe-Zn alloys + Fe base) offers the metal base very high protection against corrosion.

The internal Fe-Zn alloys are even harder than steel, while the external layer of pure zinc is softer. This means that the system acts as a type of “cushion” which is very resistant to blows and scratches.



100 % recyclable material

Once removed from the installation, the material can be used and taken advantage of as raw material in the making of new metallic products, thus avoiding the use of new raw materials and subsequent energy waste.

Versatility

The wide range of existing references and the ease with which the installations are performed means that the fittings can be adapted to any design requisite.

Quality

The manufacturing of the fittings is undertaken in accordance with the UNE-EN-ISO 9011 standard for Quality Control Systems. This standard undergoes regular checks by highly recognised European control organisations.

6.1. FACTORS REGARDING CORROSION

Most occurrences of metallic corrosion are, by nature, electrochemical (the contact of metals with means which provide conductivity such as salt solutions, water, humidity, etc.).

In these circumstances, and due to the electrochemical potentials which are present in different parts of the metal, anodic and cathodic areas are generated making the water act as an electrolyte. The consequence is the destruction of the metal which ends up turning into corrosive products (generally hydroxides or metal hydrated oxides).

By applying it to galvanized products, zinc has the capacity to form passivation layers which insulate the iron from the harmful agent. Thus, by being more electronegative than iron, it will act as an anode zone, which will mean that the corrosion will attack this and will leave the iron protected.

Passivation products (basically simple hydrated carbonates) are more insoluble in water, very adherent and not very porous, forming a thin layer on the surface of the fitting which prevents the advance of possible corrosion.

BASIC PREVENTION OF CORROSION IN THE EXTERIOR OF THE PIPES

Experience has shown that the principal agents which cause corrosion in the exterior of the pipes are certain aggressive building materials (gypsum, plaster, scoria,...) which usually act only in the presence of humidity.

Thus, it is essential to avoid as much as possible the presence of humidity when installing the pipes in the open or in exposed areas. If this is not possible, the following is recommended:

- Before covering the installation:
 - Carry out a pressure test to ensure the absence of any type of leakage.
 - Clean appropriately and avoid any contact with gypsum, plaster....
 - Avoid contact between the pipes and heterogeneous materials (Gravel, rubble,...) which allow air pockets and also avoid the forming of differential aeration.
- Cover the hot water pipes with an insulating covering or wrapper which does not absorb humidity and which allows adjustment to temperature changes (expansion, contraction). Avoid fibreglass wool lagging or mineral fibres because these absorb and retain humidity. Waterproof materials should be used.
- Cover the cold water pipes with cement slurry (Portland for example), especially the parts which are in contact with the ground and walls.
- Apply a final layer of cement mortar (this must not contain any unwashed beach sand or additives with chlorides).

Apart from the nature of the water used (pH, concentration of salts and gases, aggressiveness, contamination ...), the following is recommended in order to minimize the risk of corrosion.

- Use treated waters.
- Use joints of the same nature (do not mix galvanized parts with non galvanized parts). Soldering carried out on galvanized parts will cause damage (especially to interior surfaces).
 - Avoid the presence of materials in the interior of the pipes (shavings, burr, etc).
 - Avoid the use of metals of different nature (steel-copper).
 - Avoid air getting in by using the correct design for the installation (necessary pumping and purges, etc).
- Encourage the creation of a passivation layer (at the beginning clean and let the water run a while, do not empty or leave the installation half empty, etc).
 - Control the temperature of the hot water.
 - Avoid the use of the pipes as earth in electrical installations.

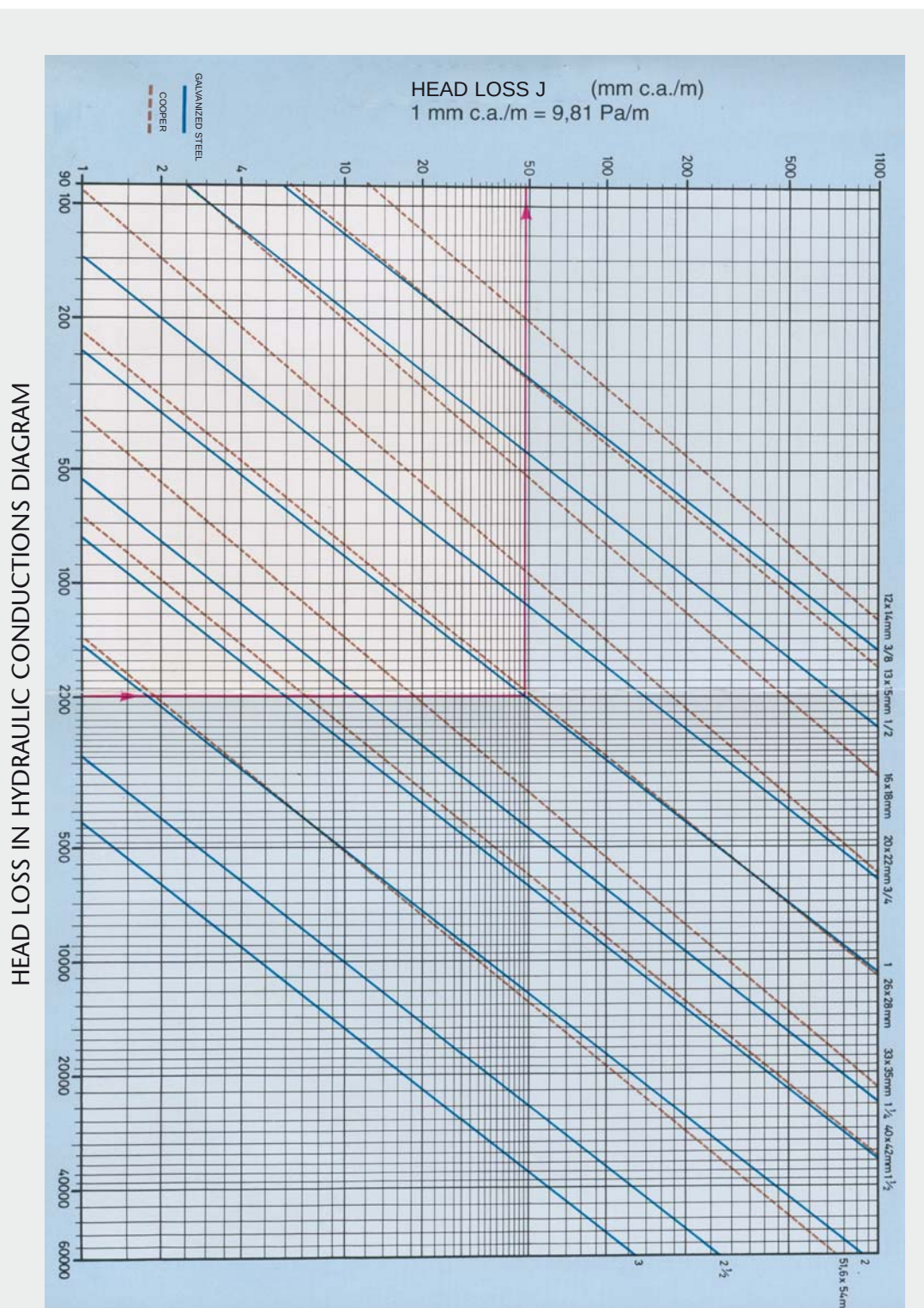
All in all, both interior and exterior installations should be carried out in accordance with the technical instructions and code of good practice and also follow the legal requisites applicable.

6.2. HEAD LOSS

In fluid conduction installations it is necessary to carry out, at all times, the adequate service pressure at the lowest energetic cost. For this reason, head loss is one of the most important factors to bear in mind for the correct calculation and dimensionality of the installations.

As it advances, the fluid must overcome the resistance of the friction against the walls (LOCALIZED losses – “linear loss”) and the resistance when it passes through special sections in valves, expansions, reductions, elbow joints, etc. (SINGULAR losses – losses through “equivalent length”).

The energy loss to overcome these resistances is called head loss. In order to be calculated, certain empirical expressions are used (Darcy-Weisbach, Hazen-Williams, etc) along with experimental calculations. However, for a fast and approximate calculation the following framework can be used:



Equivalent lengths (in mm) of head loss corresponding to different elements of hydraulic systems.

Nominal diameter of pipe		3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
Type of isolated resistance		10	15	20	25	32	40	50	65	80	100
	Socket	0,00	0,00	0,02	0,03	0,04	0,05	0,06	0,09	0,12	0,15
	Reducing taper	0,20	0,30	0,50	0,65	0,85	1,00	1,30	2,00	2,30	3,00
	Sweep bend 90°	0,20	0,34	0,43	0,47	0,56	0,70	0,83	1,00	1,18	1,25
	Elbow 90°	0,18	0,33	0,45	0,60	0,84	0,96	1,27	1,48	1,54	1,97
	Tee 45°	0,38	0,50	0,63	0,76	1,01	1,32	1,71	1,94	2,01	2,21
	Twin Elbow	1,02	0,84	0,90	0,96	1,20	1,50	1,80	2,10	2,40	2,70
	Reducing tee	1,50	1,68	1,80	1,92	2,40	3,00	3,60	4,20	4,80	5,40
	Branching tee	0,10	0,15	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90
	Check valve swing with piston	1,80	2,50	3,00	3,60	4,10	4,60	5,00	5,50	6,20	6,90
	Válvula de retención paso de escuadra	0,20 1,33	0,30 1,70	0,55 2,32	0,75 2,85	1,15 3,72	1,50 4,67	1,90 5,75	2,65 6,91	3,40 8,40	4,85 11,1
	Válvula de compuerta abierta	5,10	5,40	6,50	8,50	11,50	13,0	16,5	21,0	25,0	36,0
	Válvula de paso recto y asiento reclinado	0,14	0,18	0,21	0,26	0,36	0,44	0,55	0,69	0,81	1,09
	Válvula de paso recto y asiento reclinado	1,10	1,34	1,74	2,28	2,89	3,46	4,53	5,51	6,69	8,80
	Ball valve	4,05	4,95	6,25	8,25	10,8	13,0	17,0	21,0	25,0	33,0
	Corner or angled valve (open)	1,90	2,55	3,35	4,30	5,60	6,85	8,60	11,1	13,7	17,1
	Válvula de asiento (paso recto)	–	3,40	3,60	4,50	5,65	8,10	9,00	–	–	–
	Exchanger	–	–	–	2,1	5	12,5	13,2	14,2	25	–
	Radiator	2,50	3,00	3,50	4,00	4,50	5,00	5,75	6,50	7,00	7,50
	Radiator with valves	3,75	4,40	5,25	6,00	6,75	7,50	8,80	10,10	11,40	12,70
	Boiler	2,50	3,00	3,50	4,00	4,50	5,00	5,75	6,50	7,00	7,50
	Boiler with valves	3,00	4,20	4,90	5,60	6,30	7,00	8,00	8,75	9,50	10,00
	Meter	general 45 m c.a. individual or divisional 10 m c.a.									

6.3. PRESSURE SURGE

Incompressible fluids have a certain amount of elasticity. Because of this, when the circulation of the fluid is stopped suddenly (a sudden closure of a component, e.g. a valve) part of the fluid hits against the element reducing its velocity to zero. At the same time, the "previous part" of the fluid continues its motion and hits against the "stopped" part generating an overpressure which tends to "compress" the fluid and "tense" the walls of the tube. This makes the fluid circulate in the opposite direction to the overpressure and at the same time generate a depression in the area of the valve.

This overpressure can become a pressure wave which reaches the other end of the tube. If energy of this pressure wave does not dissipate (e.g. in an atmospheric pressure tank), it will be reflected and will tend to lose its energy by compressing the fluid and dilating the tube.

This phenomenon will always be produced when the time taken to close the valve is less than the time of the expansion of the impact of the waves (from the valve to the end of the tube and back again to the valve). This phenomenon can be very dangerous given that it can increase the pressure in the tube 100 times.

Its energy is directly proportional to the length of the tube and inversely proportional to the time taken to close the valve. The shorter the time taken to close the valve, the greater the impact.

Possibility of a pressure surge

Being T_p the time of the expansion of the impact (s) and T_c the time taken to close the valve (s), it may happen that:

$T_c \leq T_p$: what amounts to an instantaneous closure, given that the time taken for the pressure wave to return is greater than that of the closure. A pressure surge will be produced.

$T_c > T_p$: . A pressure surge will not occur, given that the pressure wave will return to the valve while it is still partially open.

Calculating the increase in pressure (ΔP) produced by a pressure surge

The increase in pressure is calculated as:

$$\Delta P = \rho c \Delta V$$

ΔP = change in the pressure (Pa)

ΔV = change in the velocity of the fluid flow as a result of the closure of the valve (m/s)

c = velocity of the pressure wave (m/s)

ρ = density of the fluid (kg/m³)

$$\text{with } c = S_1 \sqrt{\frac{Es}{\rho [1 + (Es/E) + (d/e)]}}$$

con Es = módulo de elasticidad volumétrico (Pa) del fluido

E = módulo Young del material de la tubería (Pa)

d, e = diameter and thickness of the tube (mm)

$$\text{and } T_p = 2L/c$$

with L = length of the tube (m)

6.4. UNIT CONVERSION TABLE

PRESSURE (MKS INTERNATIONAL SYSTEM): $\text{ML}^{-1} \text{T}^{-2}$

	bar	atm	kg_f/cm^2	N/m^2	kPa	psi	mm Hg a 0°C	mm H ₂ O a 4°C
1 bar	1	0,9869	1,0197	1×10^5	100	14,5038	750,0627	10.197,4477
1 atm física (atm)	1,0132	1	1,0332	$1,0132 \times 10^5$	101,325	14,6959	760	10.332,28
1 atm tca (kg_f/cm^2)	0,9806	0,9678	1	$0,9807 \times 10^5$	98,0665	14,2233	735,5602	10.000,28
1 Pa (1 N/m^2)	1×10^{-5}	$0,9869 \times 10^{-5}$	$1,0197 \times 10^{-5}$	1	0,001	0,000145	0,0075	0,1019
1 kPa	0,01	0,0099	0,01019	1×10^3	1	0,1450	7,5006	101,9745
1 psi (lb_f/in^2)	0,0689	0,0681	0,0703	6.894,7573	6,8947	1	51,7150	703,6
1 mm Hg a 0°C	$1,3332 \times 10^{-3}$	0,0013	$1,3595 \times 10^{-3}$	133,3222	0,1333	0,0193	1	13,5955
1 mm H ₂ O a 4°C	$9,8064 \times 10^{-5}$	$0,9678 \times 10^{-4}$	1×10^{-4}	9,8064	0,0098	0,0014	0,0735	1

ENERGY (MKS INTERNATIONAL SYSTEM): $\text{ML}^2 \text{T}^{-2}$

	Kcal	kWh	kJ	BTU	HP h	CV h
1 Kcal	1	$1,163 \times 10^{-3}$	4,184	3,9682	0,00156	$1,5812 \times 10^{-3}$
1 kW h	860,3	1	3.600	3.412,96	1,3410	1,3596
1 kJ (1 kW s)	0,2390	$2,777 \times 10^{-4}$	1	0,9487	$3,7251 \times 10^{-4}$	$3,7767 \times 10^{-4}$
1 BTU	0,2519	$2,9307 \times 10^{-4}$	1,054	1	$3,9301 \times 10^{-4}$	$3,9847 \times 10^{-4}$
1 HP h (USA)	641,1865	0,7457	2684,5195	2.544,43	1	1,0139
1 CV h (métrico)	632,42	0,7355	2.647,7955	2.509,63	0,9863	1

TEMPERATURE SCALE

°C: Celsius	-273,16	0	50	100
K: Kelvin	0	273,16	323,16	373,16
F: Fahrenheit	-459,68	32	122	212
R ó Ra: Rankine	0	0	581,68	671,68
R: Reamur	-218,52	0	40	80

TEMPERATURE CONVERSION

$C \Rightarrow F: F = 1,8 C + 32$	$F \Rightarrow C: C = (F - 32)/1,8$	$K \Rightarrow C: C = K - 273,16$	$R \Rightarrow C: C = 1,25 C$
$C \Rightarrow K: K = C + 273,16$	$F \Rightarrow K: K = (F + 459,68)/1,8$	$K \Rightarrow F: F = 1,8 K - 459,68$	$R \Rightarrow F: F = (9/4) R + 32$
$C \Rightarrow Ra: Ra = 1,8 C + 491,68$	$F \Rightarrow Ra: Ra = F + 459,68$	$K \Rightarrow Ra: Ra = 1,8 K$	$R \Rightarrow K: K = 1,25 C + 273,16$
$C \Rightarrow R: R = 0,8 C$	$F \Rightarrow R: R = (F - 32) \cdot (4/9)$	$K \Rightarrow R: R = 0,8 K - 218,52$	$R \Rightarrow Ra: Ra = (9/4) R + 491,68$



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