D-M-E Metric Components

A comprehensive line of Euro-Standard metric components

A comprehensive line of Euro-Standard metric components

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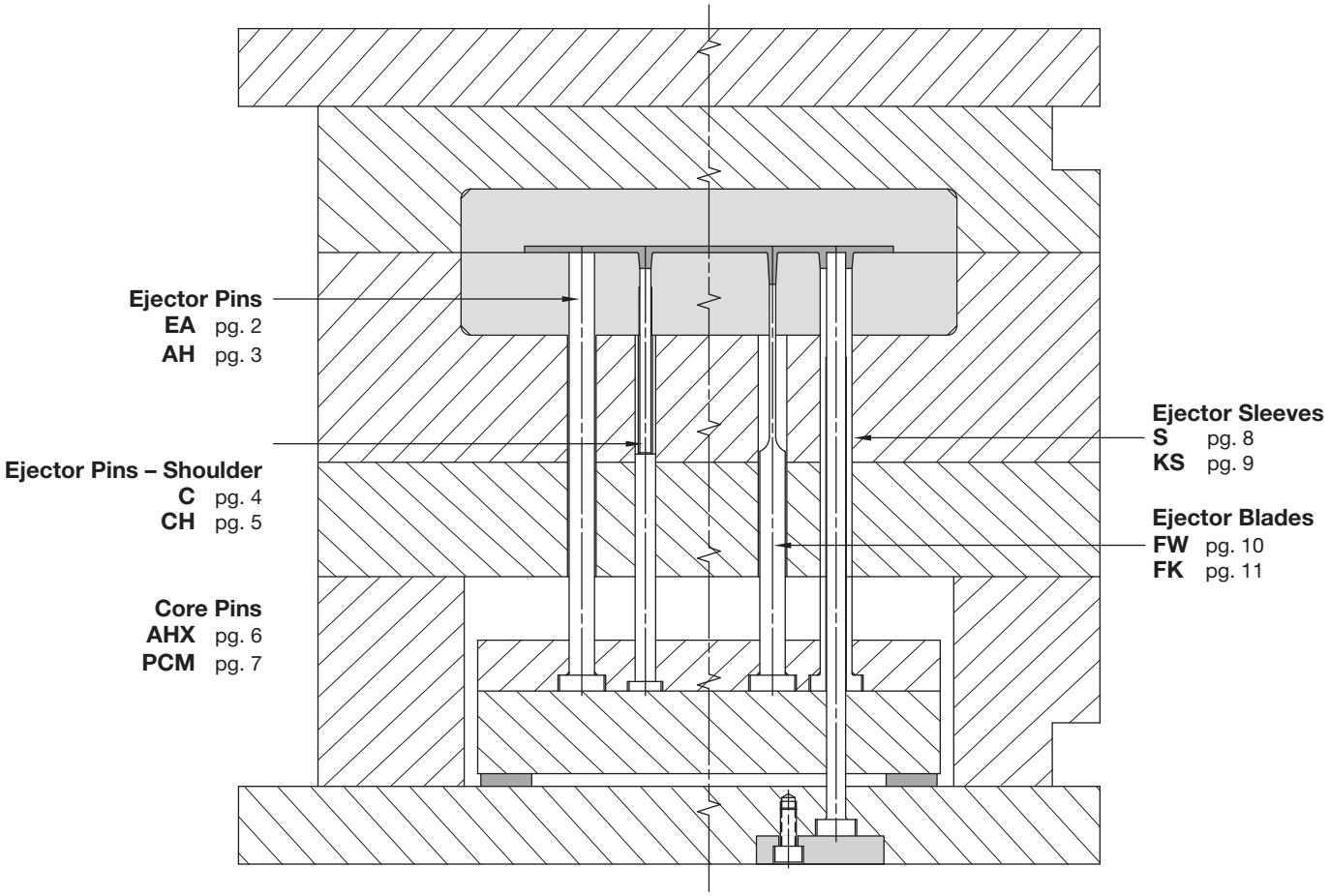
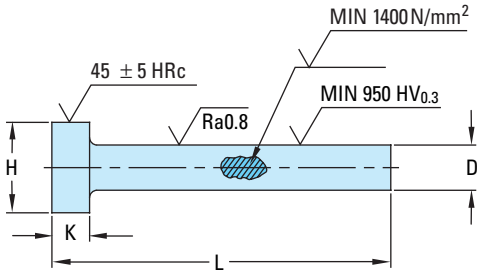
Pins and Sleeves Table of Contents



Ejector pins – nitrided

- Expulsores
- Ejecteurs epingles
- Extractores
- Auswerferstifte



DIN TYPE

500°-550°C (932°-1022°F)

Mat. 1.2344 (H13)

Nitrided

- Nitrurados
- Nitruré
- Nitrurados
- Nitriert

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D g6	H	K	L +2 0													
				0100	0125	0160	0200	0250	0315	0400	0500	0630	0800	1000	1250	1600	2000
EA	01.0	3	2														
	01.2	3	2														
	01.5	3	1.5														
	01.7	3.5	2														
	02.0	4	2	⚡		⚡											
	02.2	4	2														
	02.5	5	2														
	02.7	5	2														
	03.0	6	3	⚡		⚡	⚡	⚡									
	03.2	6	3														
	03.5	7	3														
	03.7	7	3														
	04.0	8	3	⚡		⚡	⚡	⚡	⚡								
	04.2	8	3														
	04.5	8	3														
	05.0	10	3	⚡		⚡	⚡	⚡	⚡	⚡							
	05.2	10	3														
	05.5	10	3														
	06.0	12	5	⚡		⚡	⚡	⚡	⚡	⚡	⚡						
	06.2	12	5														
	06.5	12	5														
	07.0	12	5														
	07.5	12	5														
	08.0	14	5	⚡		⚡	⚡	⚡	⚡	⚡	⚡	⚡					
	08.2	14	5														
	08.5	14	5														
	09.0	14	5														
	09.5	14	5														
	10.0	16	5			⚡	⚡	⚡	⚡	⚡	⚡	⚡					
	10.2	16	5														
	10.5	16	5														
	11.0	16	5														
	12.0	18	7			⚡	⚡	⚡	⚡	⚡	⚡	⚡					
	12.2	18	7														
	12.5	18	7														
	14.0	22	7														
	16.0	22	7			⚡	⚡	⚡	⚡	⚡	⚡	⚡					
	18.0	24	7														
	20.0	26	8					⚡	⚡	⚡	⚡	⚡					
	25.0	32	10						⚡	⚡	⚡	⚡					
	32.0	40	10														

*To order, specify Item Number in following fashion:

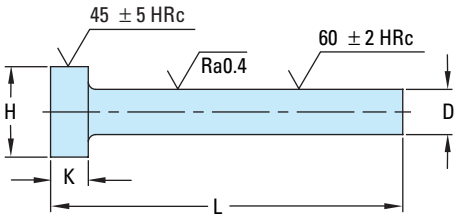
Prefix	D	L	
EA			e.g. EA 082 0200
			EA 030 0160

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Ejector pins – hardened

- Expulsores
- Ejecteurs epingles
- Extractores
- Auswerferstifte



DIN TYPE

250°C (482°F)

Mat. 1.2210 (L2)

Hardened

- Templados
- Trempé
- Temperado
- Gehärtet

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D g6	H	K	L +2 0													
				0040	0060	0080	0100	0125	0160	0200	0250	0315	0400	0500	0630	0800	1000
AH	01.5	3	1.5				⚡	⚡	⚡	⚡							
	01.6	3	1.5														
	01.7	3	1.5														
	01.8	3	1.5														
	02.0	4	2				⚡	⚡	⚡	⚡	⚡						
	02.2	4	2														
	02.5	5	2				⚡	⚡	⚡	⚡	⚡						
	02.7	5	2														
	03.0	6	3				⚡	⚡	⚡	⚡	⚡						
	03.2	6	3														
	03.5	7	3														
	03.7	7	3														
	04.0	8	3				⚡	⚡	⚡	⚡	⚡						
	04.2	8	3														
	04.5	8	3														
	04.7	8	3														
	05.0	10	3				⚡	⚡	⚡	⚡	⚡						
	05.2	10	3														
	05.5	10	3														
	06.0	12	5														
	06.2	12	5														
	06.5	12	5														
	07.0	12	5														
	08.0	14	5														
	08.2	14	5														
	08.5	14	5														
	09.0	14	5														
	10.0	16	5														
	10.2	16	5														
	10.5	16	5														
	11.0	16	5														
	12.0	18	7														
	12.2	18	7														
	12.5	18	7														
	14.0	22	7														
	16.0	22	7														
	18.0	24	7														
	20.0	26	8														

*To order, specify Item Number in following fashion:

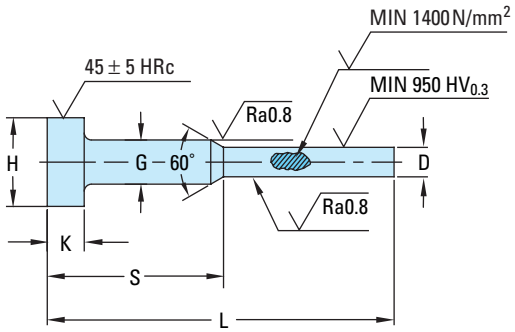
Prefix	D	L	
AH			e.g. AH 015 0125 AH 040 0125

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Shoulder ejector pins – nitrided

- Expulsores
- Ejecteurs epingles
- Extractores
- Auswerferstifte



DIN TYPE

500°-550°C (932°-1022°F)

Mat. 1.2344 (H13)

Nitrided

- Nitrurados
- Nitruré
- Nitrurados
- Nitriert

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D g6	G 0 -0.1	H	K	L +2 0						
					0080	0100	0125	0160	0160	0200	0250
					S -1 -2						
					0035	0050	0050	0050	0075	0075	0075
C	00.7	2	4	2							
	00.8	2	4	2							
	0.09	2	4	2							
	01.0	2	4	2		⚡	⚡	⚡		⚡	
	01.1	2	4	2							
	01.2	2	4	2		⚡	⚡		⚡	⚡	
	01.3	2	4	2							
	01.4	2	4	2							
	01.5	3	6	3		⚡	⚡	⚡		⚡	
	01.6	3	6	3							
	01.7	3	6	3							
	01.8	3	6	3							
	01.9	3	6	3							
	02.0	3	6	3		⚡	⚡		⚡	⚡	
	02.1	3	6	3							
	02.2	3	6	3							
	02.3	3	6	3							
	02.4	3	6	3							
	02.5	3	6	3			⚡	⚡		⚡	
	02.6	3	6	3							
	02.7	3	6	3							
	02.8	3	6	3							
	02.9	3	6	3							
	03.0	4	8	3							
	03.1	4	8	3							
	03.2	4	8	3							
	03.3	4	8	3							
	03.4	4	8	3							
	03.5	4	8	3							

*To order, specify Item Number in following fashion:

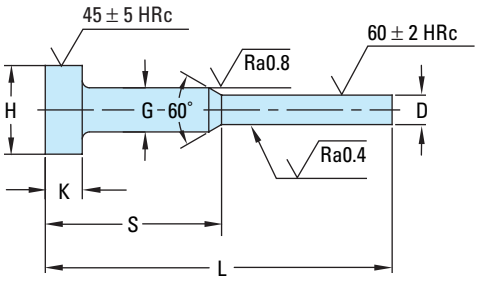
Prefix	D	L	S	
C				e.g. C 025 0125 0500

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Shoulder ejector pins – hardened

- Expulsores
- Ejecteurs epingles
- Extractores
- Auswerferstifte



DIN TYPE

250°C (482°F)

Mat. 1.2210 (L2)

Hardened

- Templados
- Trempé
- Temperado
- Gehärtet

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D g6	G	H	K	L +2 0						
					0060	0080	0100	0125	0160	0200	0250
					S -1 -2						
					0025	0035	0050	0050	0075	0075	0100
CH	00.5	2	4	2							
	00.6	2	4	2							
	00.7	2	4	2							
	00.8	2	4	2							
	00.9	2	4	2							
	01.0	2	4	2			⚡	⚡	⚡	⚡	
	01.1	2	4	2							
	01.2	2	4	2			⚡	⚡	⚡		
	01.3	2	4	2							
	01.4	2	4	2							
	01.5	3	6	3			⚡	⚡	⚡	⚡	
	01.6	3	6	3							
	01.7	3	6	3							
	01.8	3	6	3							
	01.9	3	6	3							
	02.0	3	6	3			⚡	⚡	⚡	⚡	
	02.1	3	6	3							
	02.2	3	6	3							
	02.3	3	6	3							
	02.4	3	6	3							
	02.5	3	6	3				⚡	⚡	⚡	
	02.6	3	6	3							
	02.7	3	6	3							
	02.8	3	6	3							
	02.9	3	6	3							

*To order, specify Item Number in following fashion:

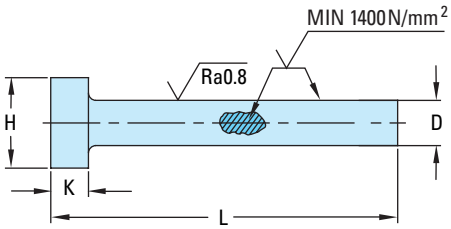
Prefix	D	L	S	
CH				e.g. CH 015 0160 0075
				CH 020 0100 0050

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Core pins – hardened

- Expulsores
- Epingles au centre
- Pernos moldantes
- Kernstifte



DIN TYPE

500°-550°C (932°-1022°F)

Mat. 1.2344 (H13)

Hardened

- Templados
- Trempé
- Temperado
- Gehärtet

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	H	K	L $^{+2}_{0}$											
				0080	0100	0125	0160	0200	0250	0315	0400	0500	0630	0800	1000
AHX	01.0	3	1.5												
	01.5	3	1.5												
	02.0	4	2		⚡		⚡	⚡							
	02.2	4	2												
	02.5	5	2												
	02.7	5	2												
	03.0	6	3		⚡		⚡	⚡	⚡						
	03.2	6	3												
	03.5	7	3												
	03.7	7	3												
	04.0	8	3		⚡		⚡	⚡	⚡	⚡					
	04.2	8	3												
	04.5	8	3												
	05.0	10	3		⚡		⚡	⚡	⚡	⚡	⚡				
	05.2	10	3												
	05.5	10	3												
	06.0	12	5		⚡		⚡	⚡	⚡	⚡	⚡	⚡			
	06.2	12	5												
	06.5	12	5												
	07.0	12	5												
	07.5	12	5												
	08.0	14	5		⚡		⚡	⚡	⚡	⚡	⚡	⚡			
	08.2	14	5												
	08.5	14	5												
	09.0	14	5												
	09.5	14	5												
	10.0	16	5				⚡	⚡	⚡	⚡	⚡	⚡			
	10.2	16	5												
	10.5	16	5												
	11.0	16	5												
	12.0	18	7					⚡	⚡	⚡	⚡	⚡			
	12.2	18	7												
	12.5	18	7												
	14.0	22	7												
	16.0	22	7						⚡	⚡	⚡	⚡	⚡		
	18.0	24	7												
	20.0	26	8						⚡	⚡	⚡	⚡	⚡		
	25.0	32	10							⚡	⚡	⚡	⚡		
	32.0	40	10												

*To order, specify Item Number in following fashion:

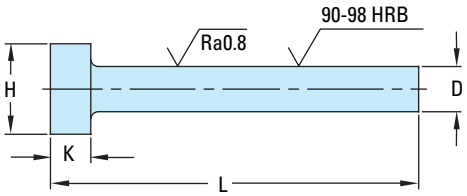
Prefix	D	L	
AHX			e.g. AHX 095 0315 AHX 032 0400

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Core pins – performance

- Expulsores
- Epingles au centre
- Pernos moldantes
- Kernstifte



DIN TYPE

350°C (662°F)

Mat. Beryllium-free copper-based alloy

- Aleación de cobre sin berilio
- Alliage de culvre sans béryllium
- Material Liga á base de cobre sem berílio
- Kupferlegierung ohne Beryllium

HIGH THERMAL CONDUCTIVITY PINS

Advantages:

- Reduced cycle time
- 5 times better conductivity than steel
- Improved part quality
- Lower machining costs
- Longer service life

Refer to Appendix E for surface finish definitions.

ITEM PREFIX*	D $^{+0.025}_{0}$	H	K	L $^{+1}_{0}$			
				0100	0160	0250	0315
PCM	01.5	3	1.5				
	02.0	4	2				
	02.5	5	2				
	03.0	6	3		⚡		
	03.5	7	3				
	04.0	8	3		⚡		⚡
	04.5	8	3				
	05.0	10	3		⚡		⚡
	06.0	12	5		⚡		⚡
	07.0	12	5				
	08.0	14	5		⚡		⚡
	10.0	16	5		⚡		⚡
	12.0	18	7				⚡
	14.0	22	7				
	16.0	22	7				

***To order, specify Item Number in following fashion:**

Prefix	D	L
PCM		

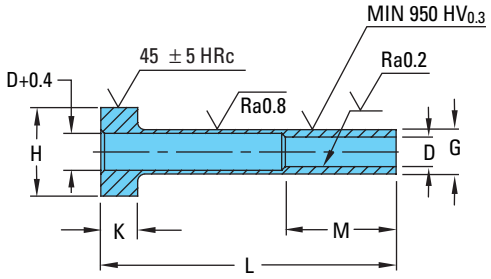
e.g. PCM 050 0160
PCM 120 0315
PCM 015 0100

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Ejector sleeves – nitrided

- Expulsores tubulares
- Ejecteurs tubulaires
- Extractores tubulares
- Auswerferhülsen



DIN TYPE

500°-550°C (932°-1022°F)

Mat. 1.2344 (H13)

Nitrided
- Nitrurados
- Nitruré
- Nitrurados
- Nitriert

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D H5	G g6	H	K	M	L +2 0											
						0075	0100	0125	0150	0175	0200	0225	0250	0275	0300	0350	0400
S	01.5	03.0	6	3	35												
	01.7	03.0	6	3	35												
	02.0	04.0	8	3	35	⚡		⚡	⚡								
	02.2	04.0	8	3	35												
	02.5	05.0	10	3	35	⚡		⚡	⚡								
	02.7	05.0	10	3	45												
	03.0	05.0	10	3	45	⚡	⚡	⚡	⚡	⚡							
	03.2	05.0	10	3	45												
	03.5	06.0	12	5	45	⚡	⚡	⚡	⚡	⚡							
	03.7	06.0	12	5	45												
	04.0	06.0	12	5	45	⚡	⚡	⚡	⚡	⚡	⚡						
	04.2	08.0	14	5	45												
	04.5	08.0	14	5	45												
	05.0	08.0	14	5	45	⚡	⚡	⚡	⚡	⚡	⚡						
	05.2	08.0	14	5	45												
	06.0	10.0	16	5	45	⚡	⚡	⚡	⚡	⚡	⚡	⚡	⚡				
	06.2	10.0	16	5	45												
	06.5	10.0	16	5	45												
	08.0	12.0	20	7	45	⚡	⚡	⚡	⚡	⚡	⚡	⚡	⚡	⚡			
	08.2	12.0	20	7	45												
	08.5	12.0	20	7	45												
	10.0	14.0	22	7	45		⚡	⚡	⚡	⚡	⚡	⚡	⚡	⚡			
	10.5	14.0	22	7	55												
	11.0	14.0	22	7	55												
	12.0	16.0	22	7	55		⚡	⚡	⚡	⚡	⚡	⚡	⚡	⚡			
	12.5	16.0	22	7	55												
	14.0	18.0	24	9	55												
	16.0	20.0	26	9	55												
	18.0	22.0	28	9	55												

*To order, specify Item Number in following fashion:

Prefix	D	G	L
S			

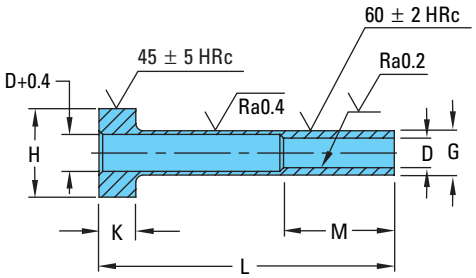
e.g. S 030 050 0125
S 035 060 0175
S 012 016 0250

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Ejector sleeves – hardened

- Expulsores tubulares
- Ejecteurs tubulaires
- Extractores tubulares
- Auswerferhülsen



DIN TYPE

250°C (482°F)

Mat. 1.2210

Hardened

- Templados
- Trempé
- Temperado
- Gehärtet

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D H5	G g6	H	K	M	L +2 0												
						0075	0100	0125	0150	0175	0200	0225	0250	0275	0300	0350	0400	0450	0500
KS	01.5	03.0	6	3	35														
	01.7	03.0	6	3	35														
	02.0	04.0	8	3	35			⚡	⚡										
	02.2	04.0	8	3	35														
	02.5	05.0	10	3	35	⚡		⚡	⚡										
	02.7	05.0	10	3	45														
	03.0	05.0	10	3	45	⚡	⚡	⚡	⚡										
	03.2	05.0	10	3	45														
	03.5	06.0	12	5	45	⚡	⚡	⚡	⚡	⚡									
	03.7	06.0	12	5	45														
	04.0	06.0	12	5	45	⚡	⚡	⚡	⚡	⚡	⚡								
	04.2	08.0	14	5	45														
	04.5	08.0	14	5	45														
	05.0	08.0	14	5	45	⚡	⚡	⚡	⚡	⚡	⚡								
	05.2	08.0	14	5	45														
	05.5	08.0	14	5	45														
	06.0	10.0	16	5	45	⚡	⚡	⚡	⚡	⚡	⚡	⚡							
	06.2	10.0	16	5	45														
	06.5	10.0	16	5	45														
	08.0	12.0	20	7	45	⚡	⚡	⚡	⚡	⚡	⚡								
	08.2	12.0	20	7	45														
	08.5	12.0	20	7	45														
	10.0	14.0	22	7	45		⚡	⚡	⚡	⚡									
	10.5	14.0	22	7	55														
	11.0	14.0	22	7	55														
	12.0	16.0	22	7	45		⚡	⚡	⚡	⚡									
	12.5	16.0	22	7	55														
	14.0	18.0	24	9	55														
	16.0	20.0	26	9	55														
	18.0	22.0	28	9	55														

*To order, specify Item Number in following fashion:

Prefix	D	G	L
KS			

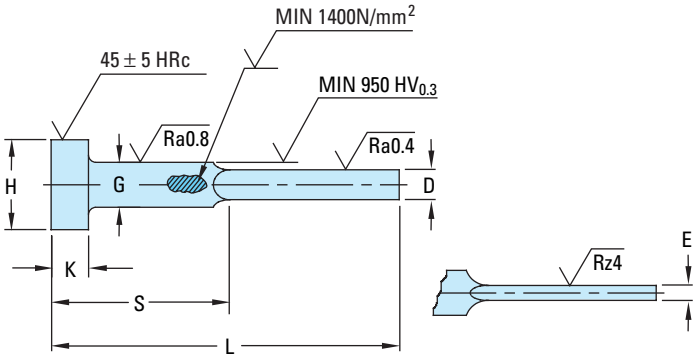
e.g. KS 020 040 0125
KS 025 050 0075
KS 082 012 0175

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Ejector blades – nitrided

- Hojas de eyección
- Ejecteurs lames
- Extractores laminares
- Auswerferklingen



DIN TYPE

500°-550°C (932°-1022°F)

Mat. 1.2344 (H13)

Nitrided

- Nitrurados
- Nitruré
- Nitrurados
- Nitriert

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	E 0 -0.015	D 0 -0.015	G 0 -0.1	H	K	L +2 0								
						0060	0080	0100	0125	0160	0200	0250	0315	0400
						S -1 -2								
						30	40	50	63	80	100	125	160	200
FW	00.8	03.5	4	8	3		■	■	■					
	01.0	03.5	4	8	3	■	■	■	■					
	01.2	03.5	4	8	3		■	■	■					
	00.8	03.8	4	8	3	■	■	■	■					
	01.0	03.8	4.2	8	3	■	■	■	⚡	⚡				
	01.2	03.8	4.2	8	3	■	■	■	■	■	■			
	01.0	04.5	5	10	3		■	■	⚡	⚡	■			
	01.2	04.5	5	10	3		■	■	■	■	■			
	01.5	04.5	5	10	3		■	■	■	■	■			
	01.6	04.5	5	10	3		■	■	■	■	■			
	01.8	04.5	5	10	3		■	■	■	■	■			
	01.0	05.5	6	12	5		■	■	⚡	⚡	■			
	01.2	05.5	6	12	5		■	■	⚡	⚡	■			
	01.5	05.5	6	12	5		■	■	⚡	⚡	⚡			
	01.6	05.5	6	12	5			■	■	■	■			
	01.8	05.5	6	12	5				■	■	■			
	02.0	05.5	6	12	5			■	⚡	⚡	⚡	■		
	01.2	07.5	8	14	5			■	■	⚡	⚡	■		
	01.5	07.5	8	14	5				■	⚡	⚡	⚡		
	01.6	07.5	8	14	5				■	■	■	■		
	01.8	07.5	8	14	5					■	■	■		
	02.0	07.5	8	14	5					⚡	⚡	⚡	⚡	
	01.5	09.5	10	16	5					■	⚡	⚡	⚡	
	01.8	09.5	10	16	5						■	■	■	
	02.0	09.5	10	16	5						⚡	⚡	■	■
	02.0	11.5	12	20	7						⚡	⚡	⚡	■
	02.5	11.5	12	20	7						⚡	⚡	⚡	■
	02.0	12.0	12.5	18	7						■	■	■	■
	02.5	12.0	12.5	18	7						■	■	■	■
	02.0	15.0	16	22	7						■	■	■	■
	02.5	15.0	16	22	7						■	■	■	■
	02.0	15.5	16	22	7						■	■	■	■
	02.5	15.5	16	22	7						■	■	■	■

*To order, specify Item Number in following fashion:

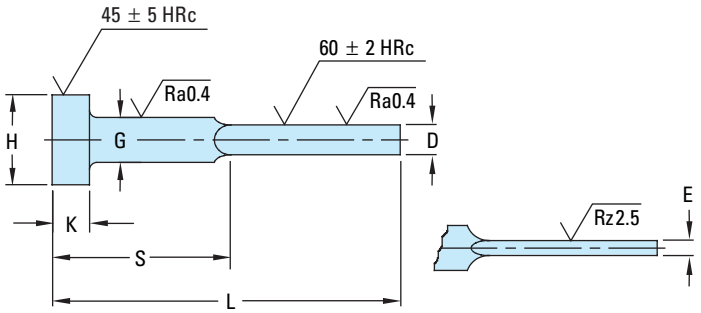
Prefix	E	D	L	
FW	■		■	e.g. FW 020 055 0125
				FW 025 115 0315

⚡ Indicates items in stock.

■ Indicates 2-3 week delivery.

Ejector blades – hardened

- Hojas de eyección
- Ejecteurs lames
- Extractores laminares
- Auswerferklingen



DIN TYPE

250°C (482°F)

Mat. 1.2210 (L2)

Hardened

- Templados
- Trempé
- Temperado
- Gehärtet

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	E $^{0}_{-0.015}$	D $^{0}_{-0.015}$	G $^{0}_{-0.1}$	H	K	L $^{+2}_{0}$ 0060	0080	0100	0125	0160	0200	0250	0315	0400
						S $^{-1}_{-2}$ 30	40	50	63	80	100	125	160	200
FK	01.0	03.5	4	8	3									
	01.2	03.5	4	8	3									
	00.8	03.8	4.2	8	3									
	01.0	03.8	4.2	8	3									
	01.2	03.8	4.2	8	3									
	01.0	04.5	5	10	3									
	01.2	04.5	5	10	3									
	01.5	04.5	5	10	3									
	01.0	05.5	6	12	5									
	01.2	05.5	6	12	5									
	01.5	05.5	6	12	5									
	02.0	05.5	6	12	5									
	01.2	07.5	8	14	5									
	01.5	07.5	8	14	5									
	02.0	07.5	8	14	5									
	01.5	09.5	10	16	5									
	02.0	09.5	10	16	5									
	02.0	11.5	12	20	7									
	02.5	11.5	12	20	7									
	02.0	15.5	16	22	7									
	02.5	15.5	16	22	7									

***To order, specify Item Number in following fashion:**

Prefix	E	D	L
FK			

e.g. FK 008 038 0060
FK 015 045 0125

Indicates items in stock.

Indicates 2-3 week delivery.

Metric pins and sleeves — for special applications

Complex part geometries, thin-wall molding, family molds, high-cavitation molds, increasingly large parts. Every day, challenging new applications and materials are forcing moldmakers to develop creative new tooling solutions. D-M-E is here to help, with comprehensive capabilities for manufacturing special pins and sleeves – quickly and cost-effectively. We offer a wide range of custom features, including:

In-house expertise

D-M-E operates a dedicated state-of-the-art manufacturing facility to ensure your quality and delivery goals are met. Extensive resources and efficient processes guarantee rapid order fulfillment. Advanced manufacturing techniques and trained, dedicated personnel ensure quality.

Quality you can count on

D-M-E starts with only the best materials for its pins and sleeves. Our proprietary hot-forging technology and in-house nitriding guarantees the finest finished components. The industry's finest surface finish provides low-friction performance for long service life.

Need innovation? Choose D-M-E

For over 55 years, moldmakers, molders and designers have trusted D-M-E for innovative, reliable solutions to their needs. Nobody beats D-M-E for quality products, quality service and quick delivery. D-M-E delivers your special pin and sleeve needs.

(See next page for faxable quote form.)

Faxable Quote Form — Full Custom Metric Pins and Sleeves

STEP 1: Photocopy this form. **STEP 2: Fill in all shaded areas.** **STEP 3: Fax to appropriate fax number below.**

Go to www.dme.net or FAX this quote to the D-M-E Hotline:

United States 888-808-4363 • Canada 800-461-9965 • International 248-398-7394

Full Custom Pins

Quantity: _____

Material H-13 ❒

Other _____

Hardness _____Rc

Nitrided Yes ❒ No ❒

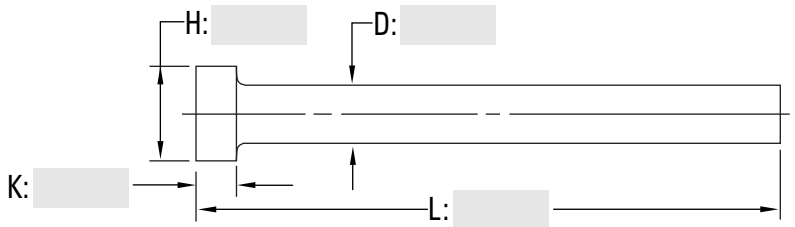
Comments _____

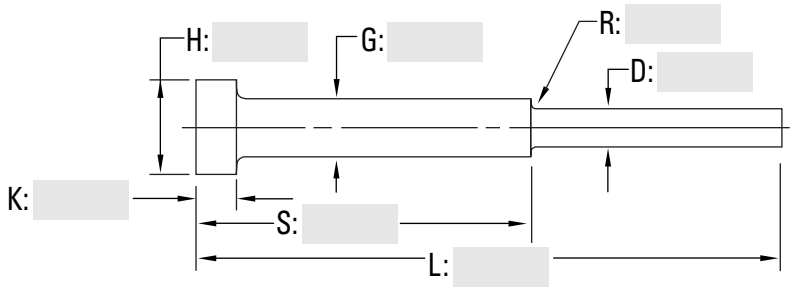
_____

_____

_____

_____





Full Custom Sleeves

Quantity: _____

Material H-13 ❒

Other _____

Hardness _____Rc

Nitrided Yes ❒ No ❒

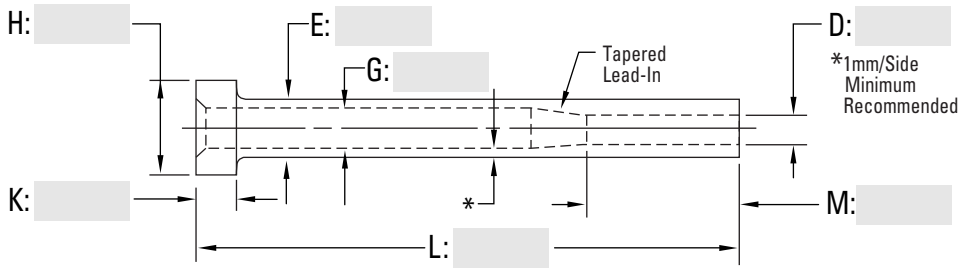
Comments _____

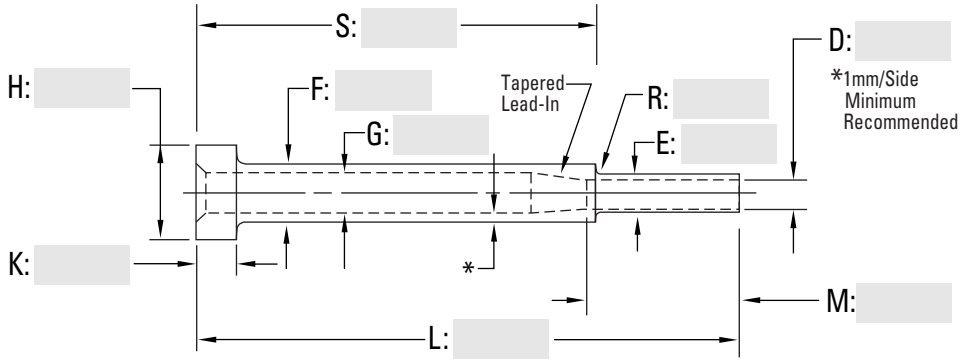
_____

_____

_____

_____





Shipping Instructions:

❒ UPS Ground
❒ UPS 2nd Day Air
❒ UPS Next Day
❒ FedEx
❒ Other

Company Name: _____ **D-M-E account #:** _____

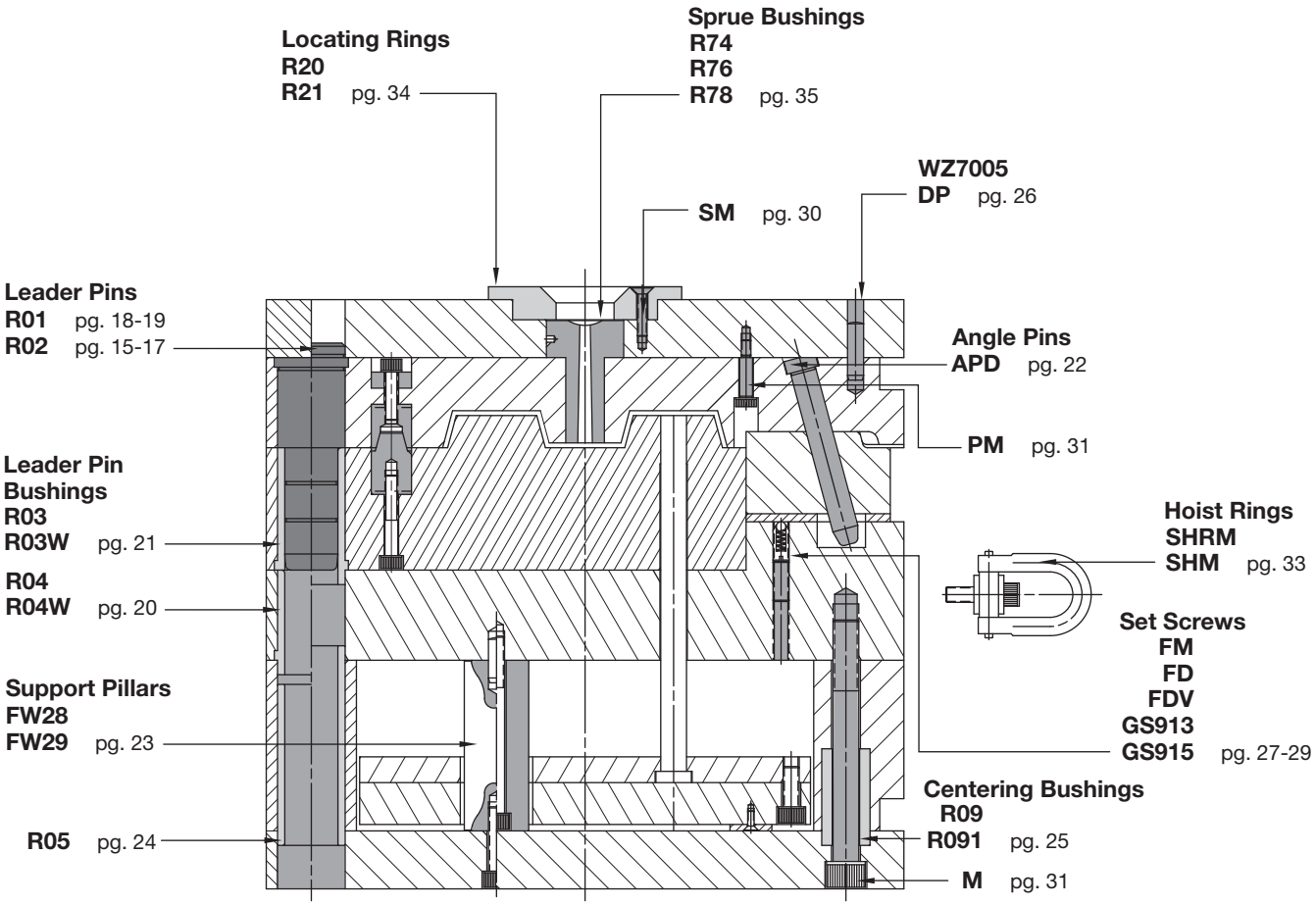
Address: _____ **City:** _____ **State:** _____ **Zip:** _____

Contact Name: _____

Phone: _____ **FAX:** _____

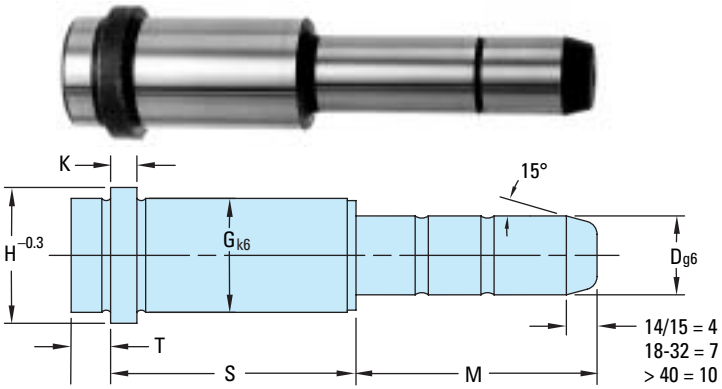
Email: _____

Mold Components Table of Contents



Leader pins with collar

- Espigas de guía con collar
- Colonnes de guidage
- Pinos condutores com gola
- Führungsstifte



KEY

D = Pin diameter
G = Shoulder diameter
H = Head diameter
K = Head length
T = Centering ring position
S = Shoulder length
M = Pin length

Mat. 1.7131 60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	H	K	T	M	S													
							012	017	022	027	036	046	056	066	076	086	096	116	136	156	196	246
R02	09/10	14	16	3	3	020		⚡		⚡												
						025			⚡		⚡											
						030				⚡												
						035			⚡													
						045					⚡											
						050				⚡												
						055																
						060																
						065																
						070																
						075																
						085																
						090																
						095																
R02	14/15	20	25	6	9	030			⚡	⚡												
						035					⚡	⚡	⚡									
						045				⚡		⚡										
						050			⚡													
						055					⚡		⚡	⚡								
						065				⚡		⚡										
						070			⚡													
						075					⚡		⚡									
						085				⚡		⚡										
						090																
						095																
						105																
						110																
						125																
						135																
						145																
						150																
						155																
						165																

*To order, specify Item Number in following fashion:

Prefix	S	D	M
R02			

e.g. R02 036 09 045
R02 066 15 055
R02 046 14 125

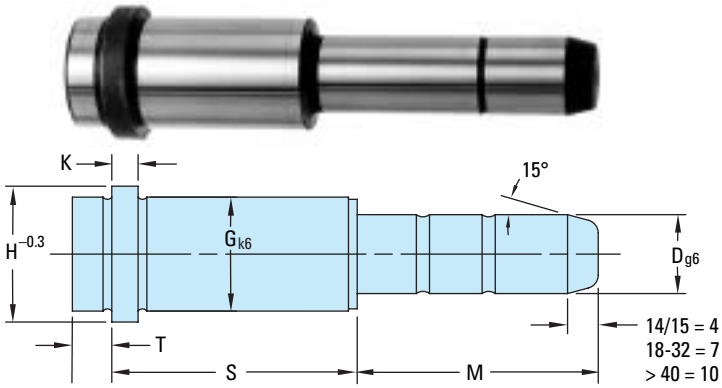
(continued)

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Leader pins with collar

- Espigas de guía con collar
- Pinos condutores com gola
- Colonnes de guidage
- Führungsstifte



KEY

D = Pin diameter
G = Shoulder diameter
H = Head diameter
K = Head length
T = Centering ring position
S = Shoulder length
M = Pin length

Mat. 1.7131 60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	H	K	T	M	S													
							012	017	022	027	036	046	056	066	076	086	096	116	136	156	196	246
R02	18/20	26	31	6	9	035				⚡	⚡	⚡	⚡									
						045				⚡		⚡										
						055					⚡		⚡	⚡	⚡							
						065				⚡		⚡										
						075					⚡		⚡	⚡	⚡							
						085				⚡		⚡										
						095					⚡		⚡									
						105						⚡										
						115																
						120																
						125																
						135																
						145																
						155																
						165				⚡												
						225																
						245																
						255																
R02	22/24	30	35	6	9	035				⚡	⚡	⚡	⚡									
						045				⚡		⚡										
						055					⚡		⚡	⚡	⚡	⚡	⚡					
						065				⚡		⚡										
						075					⚡		⚡	⚡	⚡	⚡	⚡	⚡				
						085				⚡		⚡										
						095					⚡		⚡	⚡	⚡	⚡	⚡		⚡			
						105						⚡										
						115					⚡		⚡		⚡			⚡				
						125						⚡					⚡					
						130																
						135					⚡											
						145																
						155								⚡								
						165					⚡	⚡	⚡									
						205					⚡	⚡										
						245					⚡											
						285																

*To order, specify Item Number in following fashion:

Prefix	S	D	M
R02			

e.g. R02 046 18 045
R02 136 24 095
R02 046 22 165

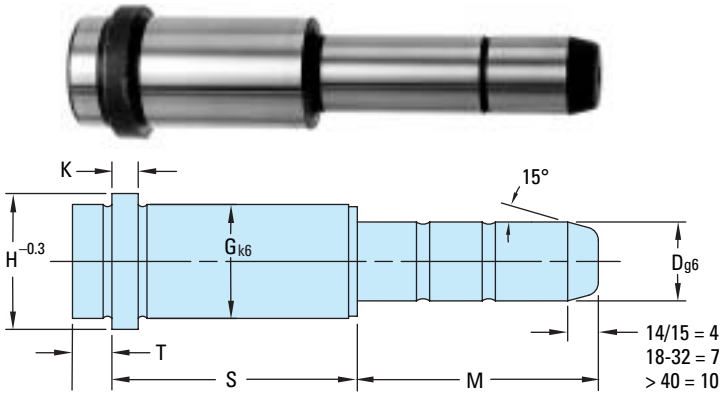
(continued)

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Leader pins with collar

- Espigas de guía con collar
- Colonnes de guidage
- Pinos condutores com gola
- Führungsstifte



KEY

D = Pin diameter
G = Shoulder diameter
H = Head diameter
K = Head length
T = Centering ring position
S = Shoulder length
M = Pin length

Mat. 1.7131 60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	H	K	T	M	S													
							012	017	022	027	036	046	056	066	076	086	096	116	136	156	196	246
R02	30/32	42	47	6	9	045				■		■										
						055					■		■	■	■	■	■					
						065				■		■										
						075					■		⚡	■	⚡	■	⚡	⚡				
						085						■										
						095					■		■	⚡	⚡	⚡	⚡		■			
						105				■		■										
						115					■		■	■	⚡		⚡	⚡	⚡	⚡		
						125						■										
						135							■	■								
						155					■				⚡			⚡	⚡	⚡	■	
						165				■		■										
						175							■	■								
						185				■												
						195															■	
						205				■							■					
						225									■	■						
						245				■	■	■	■	■								
						285				■	■	⚡										
						295							■	■								
R02	40/42	54	60	10	12	075							■	■	■	■	■					
						095						■						■	■			
						115							■		■		■			■		
						135								■		■		■	■			
						155							■				■			■	■	
						165						■										■
						175									■							
						195							■					■			■	
						215													■	■		
						235															■	
						245																■

*To order, specify Item Number in following fashion:

Prefix	S	D	M
R02			

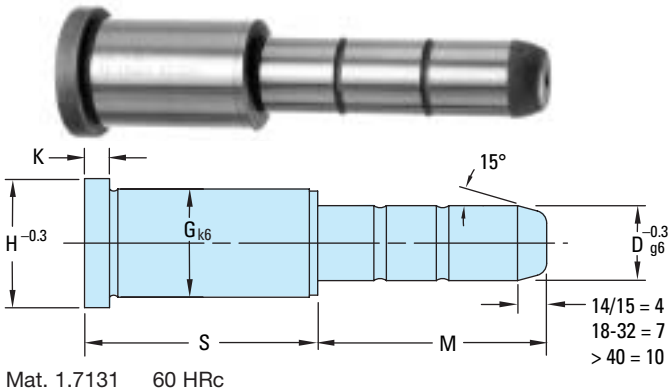
e.g. R02 156 30 115
R02 046 32 285
R02 056 30 075

⚡ Indicates items in stock.

■ Indicates 2-3 week delivery.

Leader pins

- Espigas de guía
- Pinos condutores
- Colonnes de guidage
- Führungsstifte



KEY

D = Pin diameter
G = Shoulder diameter
H = Head diameter
K = Head length
S = Shoulder length
M = Pin length

Mat. 1.7131 60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	H	K	M	S												
						017	022	027	036	046	056	066	076	086	096	116	136	156	196
R01	09/10	14	16	3	020														
					025														
					030														
					035														
					045														
					050														
					055														
R01	14/15	20	25	6	020														
					035				⚡										
					040														
					045				⚡										
					050														
					055			⚡	⚡										
					065			⚡											
					070														
					075														
					085			⚡											
					090														
					095														
					105			⚡											
					110		⚡												
R01	18/20	30	35	6	020														
					035				⚡		⚡								
					040														
					045					⚡									
					050														
					055			⚡			⚡	⚡		⚡	⚡				
					060														
					065			⚡											
					070														
					075				⚡										
					080														
					085			⚡		⚡									
					095				⚡										
					105			⚡		⚡									
					115		⚡		⚡										
					125			⚡											
					135				⚡										
					165					⚡									

(continued)

*To order, specify Item Number in following fashion:

Prefix	S	D	M
R01			

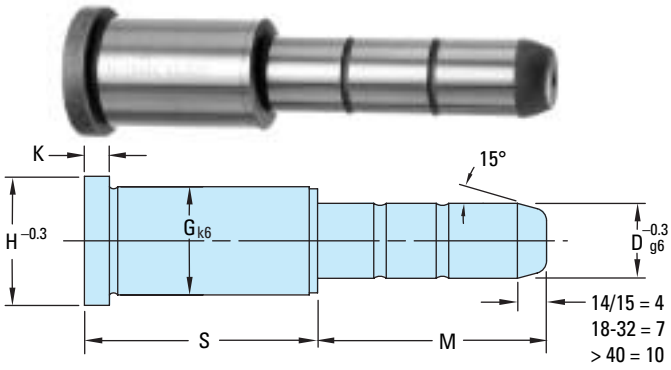
e.g. R01 036 14 055
R01 096 20 055
R01 017 09 030

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Leader pins

- Espigas de guía
- Pinos condutores
- Colonnes de guidage
- Führungsstifte



Mat. 1.7131 60 HRc

KEY

D = Pin diameter
G = Shoulder diameter
H = Head diameter
K = Head length
S = Shoulder length
M = Pin length

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	H	K	M	S												
						017	022	027	036	046	056	066	076	086	096	116	136	156	196
R01	22/24	30	35	6	025														
					045			⚡											
					050														
					055				⚡		⚡	⚡	⚡	⚡					
					060														
					065					⚡									
					070														
					075						⚡	⚡	⚡		⚡	⚡			
					080														
					085														
					095				⚡			⚡	⚡	⚡	⚡				
					105					⚡									
					115				⚡							⚡			
					125			⚡		⚡									
					135				⚡								⚡		
					155														
					165			⚡	⚡	⚡	⚡								
R01	30/32	42	47	6	045					⚡									
					055									⚡					
					065														
					075								⚡	⚡	⚡	⚡			
					085														
					095										⚡		⚡		
					105														
					115						⚡				⚡	⚡	⚡	⚡	
					125														
					135														
					155								⚡	⚡	⚡	⚡	⚡	⚡	⚡
					165					⚡									
					175						⚡								
					195														
R01	40/42	54	60	10	075														
					095														
					115													⚡	
					135														
					155														
					175														
					195						⚡								
					215														
					235														

*To order, specify Item Number in following fashion:

Prefix	S	D	M
R01			

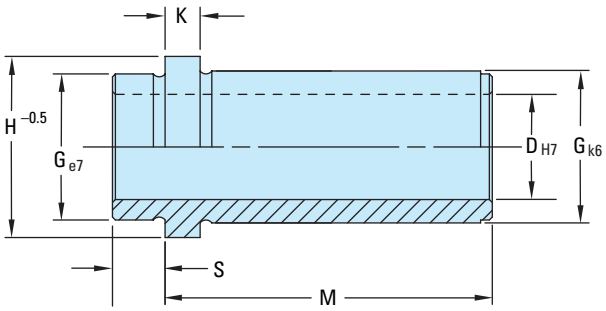
e.g. R01 156 40 115; R01 046 22 046; R01 096 32 075

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Leader pin bushings with collar

- Cojinetes de espigapara guía con collar
- Buchas de pino condutor com gola
- Douilles de guidage
- Führungsbuchsen



KEY

D = Inner diameter
G = Outer diameter
H = Head diameter
K = Head height
S = Centering ring position
M = Pin length

Mat. 1.7131 60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

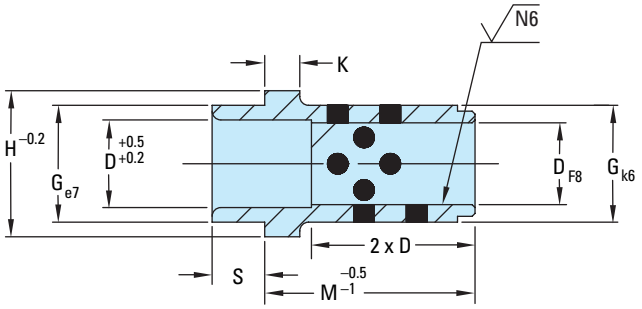
ITEM PREFIX*	D	G	H	K	S	M												
						017	022	027	036	046	056	066	076	086	096	116	136	156	196	246
R04	14/15	20	25	6	9	⚡	⚡	⚡	⚡	⚡	⚡									
	18/20	26	31	6	9	⚡	⚡	⚡	⚡	⚡	⚡	⚡								
	22/24	30	35	6	9		⚡	⚡	⚡	⚡	⚡	⚡	⚡	⚡	⚡					
	30/32	42	47	6	9									⚡	⚡	⚡	⚡			
	40/42	54	60	10	12															

***To order, specify Item Number in following fashion:**

Prefix	D	M
R04		

e.g. R04 14 017
R04 22 056
R04 32 116

Self-Lube



KEY

D = Inner diameter
G = Outer diameter
H = Head diameter
K = Head height
S = Centering ring position
M = Pin length

Mat. 1.7131 60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	H	K	S	M												
						017	022	027	036	046	056	066	076	086	096	116	136	156
R04W	09/10	14	16	3	3		⚡	⚡	⚡									
	14/15	20	25	6	9	⚡	⚡	⚡	⚡	⚡	⚡							
	18/20	26	31	6	9		⚡	⚡	⚡	⚡	⚡	⚡						
	22/24	30	35	6	9		⚡	⚡	⚡	⚡	⚡	⚡	⚡					
	30/32	42	47	6	9									⚡	⚡			
	40/42	54	60	10	12													
	40/42	51	60	10	12													

***To order, specify Item Number in following fashion:**

Prefix	D	M
R04W		

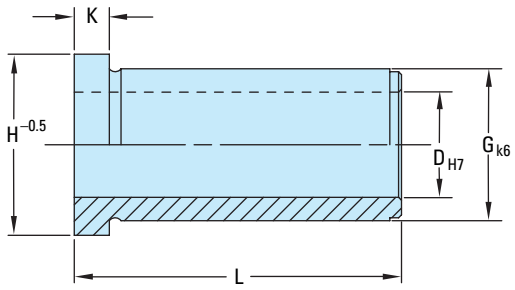
e.g. R04W 09 036
R04W 32 096
R04W 18 046

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Leader pin bushings

- Cojinetes de espiga para guía
- Buchas de pino condutor
- Douilles de guidage
- Führungsbuchsen



KEY

D = Inner diameter
G = Outer diameter
H = Head diameter
K = Head height
L = Pin length

Mat. 1.7131 60 HRc

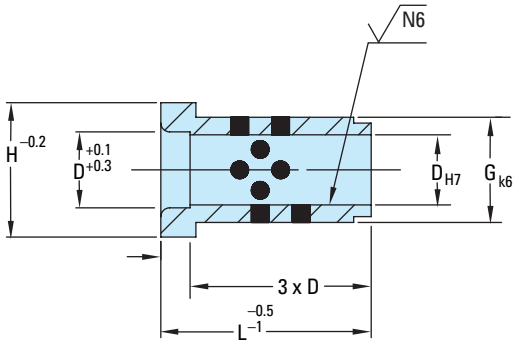
Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	H	K	L														
					009	012	017	022	027	036	046	056	066	076	086	096	116	136	156	246
R03	09/10	14	16	3				⚡	⚡	⚡										
	14/15	20	25	3			⚡	⚡	⚡	⚡	⚡	⚡								
	18/20	26	31	3			⚡	⚡	⚡	⚡	⚡	⚡	⚡							
	22/24	30	35	3				⚡	⚡	⚡	⚡	⚡	⚡	⚡	⚡	⚡				
	30/32	42	47	3											⚡	⚡	⚡	⚡		
	40/42	54	60	3																

***To order, specify Item Number in following fashion:**

Prefix	L	D	e.g.
R03			R03 32 116
			R03 20 066
			R03 09 027

Self-Lube



KEY

D = Inner diameter
G = Outer diameter
H = Head diameter
K = Head height
L = Pin length

Mat. 2.0975 Graphite 200 HB

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	H	K	L										
					017	022	027	036	046	056	066	076	086	096	116	136
R03W	09/10	14	16	3		⚡	⚡	⚡								
	14/15	20	25	3	⚡	⚡	⚡	⚡	⚡	⚡						
	18/20	26	31	3		⚡	⚡	⚡	⚡	⚡	⚡					
	22/24	30	35	3		⚡	⚡	⚡	⚡	⚡	⚡					
	30/32	42	47	3									⚡	⚡		
	40/42	54	60	3												

***To order, specify Item Number in following fashion:**

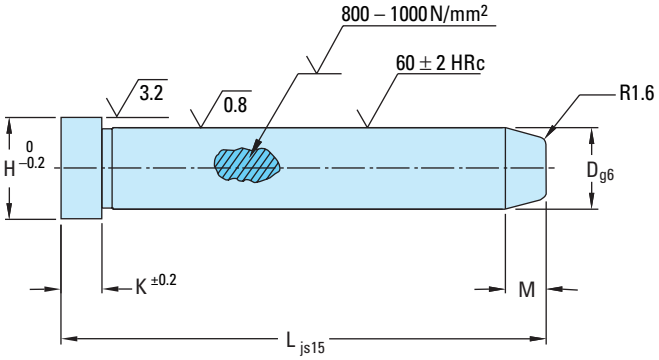
Prefix	D	L	e.g.
R03W			R03W 32 096
			R03W 18 046
			R03W 09 036

⚡ **Indicates items in stock.**

Indicates 2-3 week delivery.

Angle pins

- Espigas de ángulo
- Pinos angulares
- Epingles anglees
- Winkelstifte



KEY

D = Diameter
H = Head diameter
K = Head height
M = Taper height
L = Length

Mat. 1.7131

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	H	K	M	L																	
					040	060	080	100	120	140	160	170	180	190	200	210	220	230	240	250	270	300	360
APD	09	12	3	5																			
	10	12	3	5	⚡		⚡			⚡													
	12	16	6	5			⚡	⚡	⚡	⚡	⚡												
	14	18	8	6					⚡	⚡	⚡		⚡		⚡		⚡						
	15	18	8	7																			
	16	20	8	7				⚡	⚡	⚡	⚡		⚡		⚡		⚡	⚡					
	18	22	8	8							⚡		⚡		⚡			⚡		⚡			
	20	24	8	8					⚡	⚡	⚡		⚡		⚡			⚡	⚡				
	22	26	15	8																			
	24	28	15	8						⚡					⚡		⚡						
	30	34	15	8									⚡						⚡		⚡	⚡	
	34	38	15	8								⚡		⚡		⚡				⚡			
	40	48	15	8											⚡				⚡			⚡	
	42	48	15	10																			
	50	58	15	10															⚡			⚡	⚡

***To order, specify Item Number in following fashion:**

Prefix	D	L	
APD			e.g. APD 12 140
			ADP 10 080
			ADP 18 200

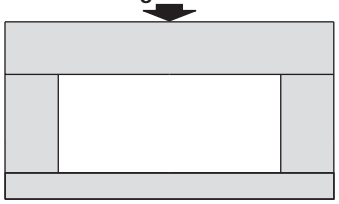
⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Support pillars

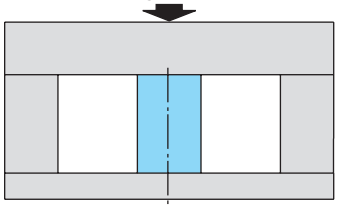
- Pilares de apoyo
- Colunas de suporte
- Colonnes de support
- Stützbolzen

Load • Carga • Charge • Carga • Druck



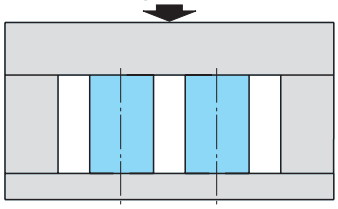
- No support pillars
- Sin pilares de apoyo
- Sans colonnes de support
- Sem colunas de suporte
- Ohne Stützbolzen

Load • Carga • Charge • Carga • Druck

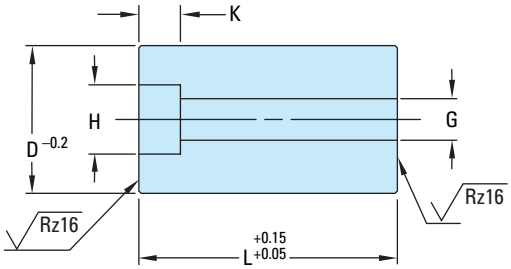


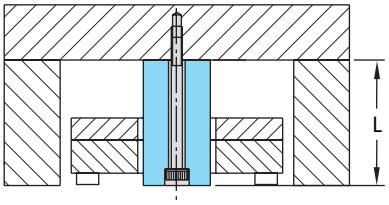
- One row of support pillars increases the permissible cavity area 4 times.
- Una fila de pilares de apoyo aumenta el área permisible de la cavidad en cuatro veces.
- Une rangée de colonnes de support augmente la surface d'empreinte admissible de 4 fois.
- Uma fileira de colunas de suporte aumenta em 4 vezes a área de cavidade permitida.
- Eine Reihe Stützbolzen erhöht die Belastbarkeit der Kavitätfläche um das 4-Fache.

Load • Carga • Charge • Carga • Druck



- Two rows of support pillars increase the permissible cavity area 9 times.
- Una fila de pilares de apoyo aumenta el área permisible de la cavidad en nueve veces.
- Deux rangées de colonnes de support augmentent la surface d'empreinte admissible de 9 fois.
- Duas fileiras de colunas de suporte aumentam em 9 vezes a área de cavidade permitida.
- Zwei Reihen Stützbolzen erhöhen die Belastbarkeit der Kavitätsfläche um das 9-Fache.





KEY

D = Outer diameter
L = Height
G = Through diameter
H = Counterbore diameter
K = Counterbore depth

Mat. 1.0718 ~640 N/mm²

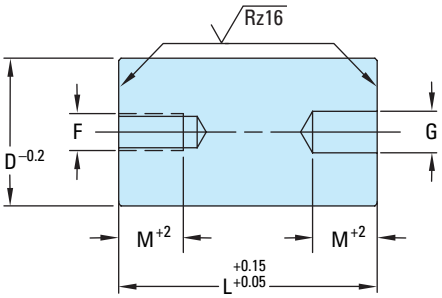
Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

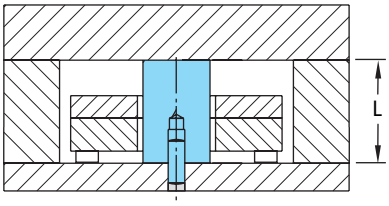
ITEM PREFIX*	D	G	H	K	L					
					046	056	076	096	116	136
FW28	32	9	15	9	⚡	⚡	⚡			
	40	11	18	11		⚡	⚡	⚡		
	50	13	20	13			⚡	⚡		
	63	13	20	13				⚡	⚡	

***To order, specify Item Number in following fashion:**

Prefix	D	L	
FW28			e.g. FW28 40 096

Support Pillars with Tap





KEY

D = Outer diameter
L = Height
G = Hole diameter
M = Hole depth
F = Tap size
N = Tap depth

Mat. 1.0718 ~640 N/mm²

ITEM PREFIX*	D	G	M	F	N	L				
						046	056	076	096	116
FW29	32	8	14	M8	14	⚡	⚡	⚡		
	40	10	18	M10	18		⚡	⚡	⚡	
	50	10	18	M10	18			⚡	⚡	
	63	10	18	M10	18				⚡	

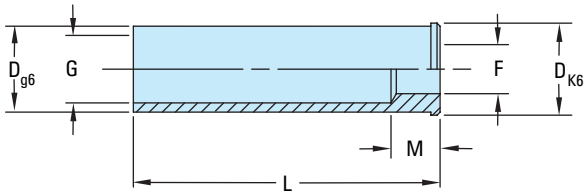
***To order, specify Item Number in following fashion:**

Prefix	D	L	
FW29			e.g. FW29 40 096

⚡ **Indicates items in stock.**
Indicates 2-3 week delivery.

Centering bushing

- Casquillo para centrar
- Bucha centralizada
- Fourrure au centre
- Mittelbuchse



KEY

D = Outer diameter
L = Overall length
G = Bearing "ID"
F = Clearance "ID"
M = Shoulder height

Mat. 1.7131 60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	F	G	M	L															
					020	030	040	050	060	070	080	100	120	140	160	180	200	240	280	300
R05	14	8	11	8																
	20	12	16	12			⚡		⚡		⚡	⚡								
	26	12	21	12			⚡		⚡		⚡	⚡	⚡							
	30	12	25	12			⚡		⚡		⚡	⚡	⚡	⚡						
	42	16	33	12					⚡		⚡	⚡	⚡	⚡						
	54	16	43	12																

***To order, specify Item Number in following fashion:**

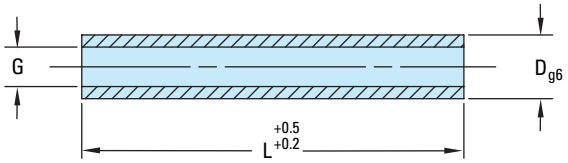
Prefix	D	L	
R05			e.g. R05 20 080
			R05 20 100
			R05 42 120

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Tubular dowel

- Clavija tubular
- Cavilha tubular
- Douaires tubulaires
- Paßhülsen



KEY

D = Outer diameter
L = Length
G = Inner diameter

Mat. 1.7131 60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	L																
			020	030	040	050	060	070	080	100	120	140	160	180	200	220	240	260	280	300
R09	10	6.2			⚡															
	14	8.5																		
	18	10.5					⚡		⚡											
	24	13					⚡		⚡		⚡									
	30	17							⚡		⚡		⚡	⚡						

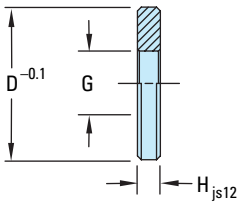
*To order, specify Item Number in following fashion:

Prefix	D	L	
R09			e.g. R09 10 040
			R09 30 160

⚡ Indicates items in stock.
Indicates 2-3 week delivery.

Washer – Tubular dowel

- Arandela – Clavija tubular
- Arruela – Cavilha tubular
- Cachetage cylindrique – Douaires tubulaires
- Scheibe – Paßhülsen



KEY

D = Outer diameter
G = Inner diameter
H = Height

Mat. 1.7131 60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	H	G
R091	14	3	6.2
	18	5	8.5
	24	4	10.5
	30	5	13.0
	40	6	17.0

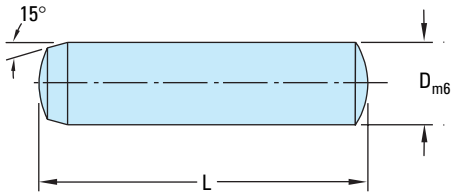
*To order, specify Item Number in following fashion:

Prefix	D	H	
R091			e.g. R091 24 4
			R091 40 6

⚡ Indicates items in stock.
Indicates 2-3 week delivery.

Dowel pins

- Cabilla
- Goupilles cylindriques
- Cavilhas
- Zylinderstifte



KEY

D = Diameter
L = Length

DIN 6325 ±60 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

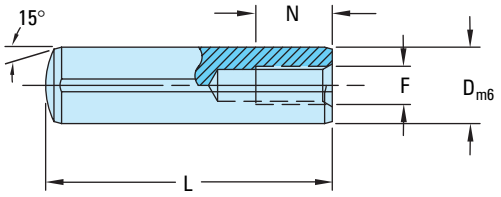
ITEM PREFIX*	D	L																		
		006	008	010	012	014	016	018	020	024	028	032	036	040	050	060	080	100	120	140
DP	02		⚡																	
	03			⚡																
	04																			
	05				⚡		⚡		⚡											
	06								⚡	⚡		⚡								
	08								⚡	⚡		⚡		⚡		⚡				
	10									⚡		⚡		⚡		⚡	⚡			
	12											⚡		⚡		⚡	⚡			
	16																⚡	⚡		⚡
	20															⚡	⚡			

***To order, specify Item Number in following fashion:**

Prefix	D	L	
DP			e.g. DP 05 012 DP 20 080

Dowel pin with tap

- Cabilla
- Goupilles cylindriques
- Cavilhas
- Zylinderstifte



KEY

D = Outer diameter
L = Length
F = Tap diameter
N = Tap depth

Hardened 650-750 HV 30

ITEM PREFIX*	D	F	N	L									
				020	024	028	032	036	040	050	060	080	100	120
WZ7005	06	M4	6	⚡			⚡		⚡					
	08	M5	8						⚡	⚡	⚡			
	10	M6	10						⚡		⚡			
	12	M6	12						⚡		⚡			
	14	M8	12											
	16	M8	16											
	20	M10	20											

***To order, specify Item Number in following fashion:**

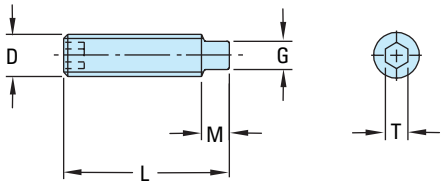
Prefix	D	L	
WZ7005			e.g. WZ7005 10 040 WZ7005 06 020 WZ7005 16 100

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Set screws – Allen head

- Tornillos de presión – cabeza Allen
- Parafusos de regulagem – cabeça Allen
- Vis de réglage
- Gewindestifte mit Zapfen



KEY

D = Thread diameter
L = Length
T = Socket size
M = Step length
G = Head diameter

DIN 915-45 H

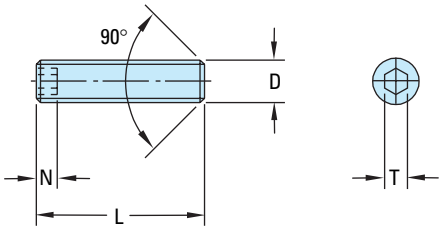
ITEM PREFIX*	T	G	M	D	L										
					010	016	018	020	025	030	035	040	045	050	060
GS915	2	2.5	3	M04											
GS915	3	4	3.5	M06		⚡			⚡						
GS915	4	5.5	5	M08											
GS915	5	7	5.5	M10											
GS915	6	8.5	7	M12											
GS915	8	12	9	M16											

*To order, specify Item Number in following fashion:

Prefix	D	L	
GS915			e.g. GS915 M06 016 GS915 M12 030

Grub screws

- Tornillos sin cabezal
- Parafusos sem cabeça
- Vis de réglage
- Gewindestifte



KEY

D = Thread diameter
L = Length
T = Socket size
N = Socket depth

DIN 913-45 H

ITEM PREFIX*	T	N	D	L											
				004	005	006	008	010	012	016	020	025	030	040	050
GS913	1.5	2.5	M03												
GS913	2	2.5	M04												
GS913	2.5	3	M05												
GS913	3	3.5	M06					⚡							
GS913	4	5	M08							⚡		⚡			
GS913	5	6	M10								⚡		⚡	⚡	
GS913	6	8	M12									⚡	⚡	⚡	⚡
GS913	6	8	M16												

*To order, specify Item Number in following fashion:

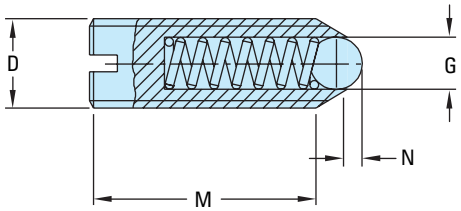
Prefix	D	L	
GS913			e.g. GS913 M06 010 GS913 M12 030

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Spring loaded set screws

- Tornillos de presión cargados por resorte
- Parafusos de regulagem de mola
- Butées à ressort
- Federnde Druckstücke



KEY

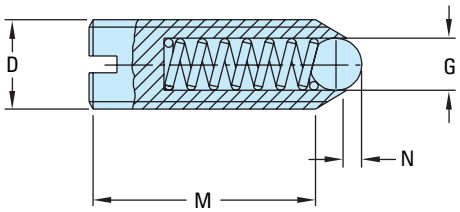
D = Thread diameter
M = Thread length
G = Ball diameter
N = Socket size
N1 = Starting load
N2 = Final load

Mat. 1.0716 FD = 100°C

ITEM NUMBER	D	M	AVAILABILITY	G	N	N1	N2
FD314	M3	14		1.5	0.5	2	3
FD49	M4	9		2.5	0.8	4	10
FD512	M5	12		3	0.9	6	11
FD614	M6	14		3.5	1	9	15
FD816	M8	16	⚡	5	1.5	18	30
FD1019	M10	19	⚡	6	2	20	40
FD1222	M12	22		8	2.5	30	55
FD1624	M16	24		10	3.5	65	120
FD2030	M20	30		12	4.5	90	140
FD2434	M24	34		15	5.5	125	180

Spring loaded set screws (high temperature)

- Tornillos de presión cargados por resorte (temperatura alta)
- Parafusos de regulagem de mola (alta temperatura)
- Butees a ressort (aux temperatures hautes)
- Federnde Druckstücke (bei hohen Temperaturen)



KEY

D = Thread diameter
M = Thread length
G = Ball diameter
N = Socket size
N1 = Starting load
N2 = Final load

Mat. 1.4305 FDV = 130°C

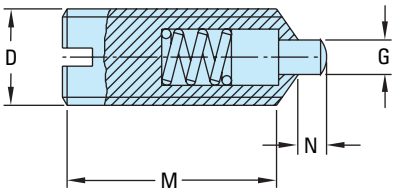
ITEM NUMBER	D	M	AVAILABILITY	G	N	N1	N2
FDV314	M3	14		1.5	0.5	2	3
FDV49	M4	9		2.5	0.6	4	10
FDV512	M5	12		3	0.9	6	11
FDV614	M6	14		3.5	1	9	15
FDV816	M8	16	⚡	5	1.5	18	30
FDV1019	M10	19	⚡	6	2	20	40
FDV1222	M12	22		8	2.5	30	55
FDV1624	M16	24	⚡	10	3.5	65	120
FDV2030	M20	30		18	4.5	90	140
FDV2434	M24	34		15	5.5	125	180

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Spring loaded set screws (plunger)

- Tornillos de presión caragados por resorte
- Butées à ressort
- Parafusos de regulagem de mola (êmbolo)
- Federnde Druckstücke (Gegenstoßel)



KEY

D = Diameter
M = Thread length
G = Plunger diameter
N = Socket size
N1 = Starting load
N2 = Final load

Mat. 1.0716

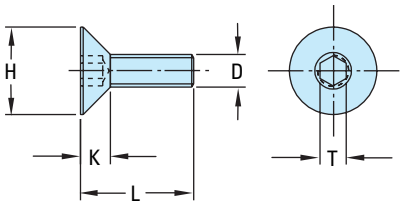
ITEM NUMBER	D	M	AVAILABILITY	G	N	N1	N2
FM49	M4	9		1.8	1.5	6	16
FM512	M5	12		2.4	2	6	17
FM614	M6	14		2.7	2	7	18
FM816	M8	16		4	2	20	35
FM1019	M10	19	⚡	4.5	2.5	20	45
FM1222	M12	22		6	3.5	25	60
FM1624	M16	24	⚡	8.5	4.5	50	95
FM2030	M20	30		10	6.5	80	140
FM2434	M24	34		12	8	100	180

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Flat head screws

- Tornillos de cabeza hueca avellanada
- Parafusos de cabeça cônica com fenda
- Vis creuses
- Senkkopfschrauben



KEY

D = Thread diameter
L = Thread length
H = Head diameter
K = Head length
T = Socket size

DIN 7991-8.8

ITEM PREFIX*	H	K	T	D	L										
					8	10	12	16	20	25	30	35	40	45	50
SM3	6	2.5	1.7	M3		⚡									
SM4	8	3	2.3	M4		⚡	⚡								
SM5	10	4	2.8	M5		⚡	⚡	⚡							
SM6	12	5	3.3	M6			⚡	⚡							
SM8	16	6	4.4	M8				⚡	⚡						
SM10	20	8	5.5	M10											
SM12	24	10	6.5	M12											

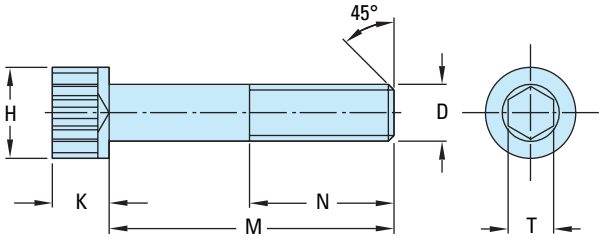
*To order, specify Item Number in following fashion:
Prefix L
e.g. SM5 16
SM12 20

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Socket head cap screws

- Tornillos prisioneros de cabeza hueca
- Parafuso de cabeça sextavada
- Vis 6-pans téte cylindrique
- Zylinderkopfschrauben



KEY

M = Length
D = Thread diameter
N = Thread length
H = Head diameter
K = Head length
T = Socket size

DIN 912 -12.9

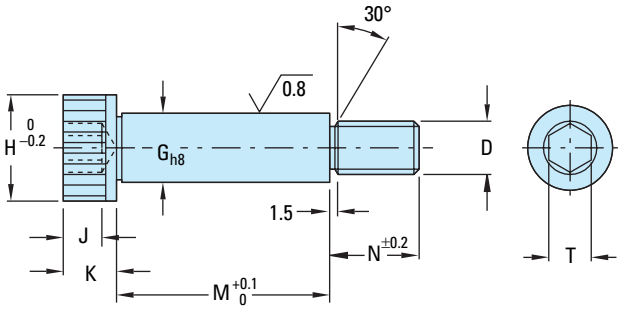
ITEM PREFIX*	N	H	K	T	M																								
					8	10	12	16	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150	160	180	200	220	240	260
M4	12	7	4	3		■			■		■																		
M6	18	10	6	5	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				■					
M8	22	13	8	6		■	■	■	■	■	■	■	■	■	■	⚡	■	⚡	■	⚡	■	■	■	■	■				
M10	25	16	10	8			■	■	■	⚡	⚡	■	■	■	■	⚡	■	⚡	■	⚡	■	■	■	■	■	■	■		■
M12	28	18	12	10					■	■	⚡	■	■	■	■	⚡	■	⚡	■	⚡	⚡	⚡	⚡	⚡	⚡	■		⚡
M16	38	24	16	14							■	■	⚡	■	■	⚡	■	⚡	■	⚡	■	■	■	■	■	■	■	■	■
M16	44	24	16	14																	⚡	⚡	⚡	⚡	⚡				
M16	57	21	10	14																						⚡	⚡	⚡	
M20	65	30	20	17										■						■		■	■	■	⚡				
M20	52	30	20	17																					⚡		⚡	⚡	

*To order, specify Item Number in following fashion:
Prefix M
e.g. M20 240
M10 30

Shoulder bolts

- Tornillos de tope
- Parafusos com ressalto
- Vis épaulées u
- Paßschrauben

Refer to Appendix E for more detail regarding surface texture callouts.



KEY

M = Shoulder length
D = Thread diameter
N = Thread length
H = Head diameter
K = Head length
G = Shoulder diameter
T = Socket size
J = Socket depth

Mat. 35 NC 6 ±1100-1200 N/mm²

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	H	K	N	G	T	J	D	M																					
								6	8	10	12	14	16	20	25	30	40	50	60	70	80	90	100	110	120	140	160	200	250
PM5	9	4	8	6	3	2.5	M5				⚡		⚡		⚡		⚡												
PM6	11	5	10	8	4	3	M6				⚡		⚡	⚡	⚡		⚡												
PM8	14	6	12	10	5	4	M8						⚡	⚡	⚡	⚡	⚡	⚡					⚡		⚡				
PM10	18	8	16	12	6	5	M10							⚡		⚡	⚡				⚡		⚡		⚡				
PM12	22	10	20	16	8	6	M12								⚡	⚡	⚡		⚡		⚡		⚡		⚡				
PM16	28	12	25	20	10	8	M16										⚡		⚡		⚡		⚡		⚡				
PM20	36	16	32	25	14	11	M20												⚡				⚡		⚡				
PM24	45	20	40	32	17	12	M24																⚡		⚡				

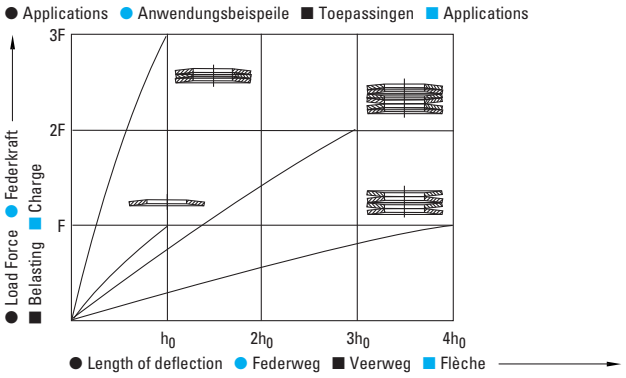
*To order, specify Item Number in following fashion:
Prefix M
e.g. PM8 20
PM20 100

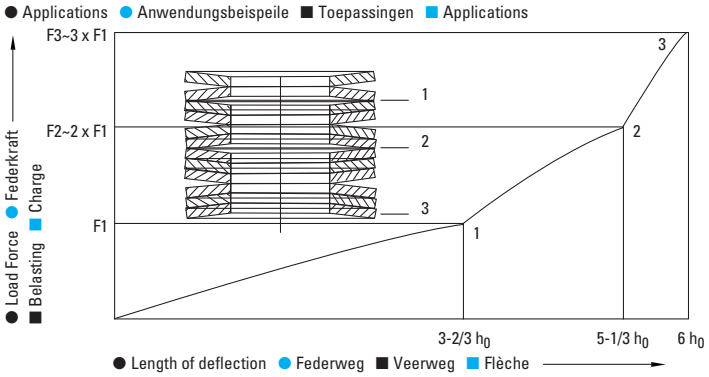
⚡ Indicates items in stock.
■ Indicates 2-3 week delivery.

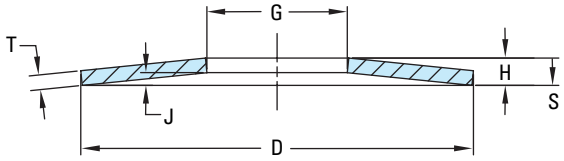
Belleville washers

- Arandelas Belleville
- Rondelles Belleville
- Arruelas Belleville
- Tellerfedern

Spring Response Curves







KEY

D = Outer diameter
G = Inner diameter
T = Thickness
H = Height
J = Height thickness
N = Force in Newtons
S = Stroke (as % of height)

Mat. 50 Cr V4 DIN 2093 Max. 300°

ITEM PREFIX*	D	G	T	H	J	S = .25 x H	N	S = .5 x H	N	S = .75 x H	N
WZ8050	16.0	08.2	0.90	1.25	.35	.087	363	.175	697	.262	1013
	18.0	09.2	1.00	1.40	.4	.1	451	.2	865	.300	1254
	20.0	10.2	1.10	1.55	.45	.112	548	.225	1050	.337	1521
	25.0	12.2	0.90	1.60	.7	.175	367	.35	644	.525	862
	31.5	16.3	1.25	2.15	.9	.225	791	.45	1409	.675	1913
	40.0	20.4	2.25	3.15	.9	.225	2336	.45	4481	.675	6500
	50.0	25.4	2.50	3.90	1.4	.35	3473	.7	6437	1.05	9063
	50.0	25.4	3.00	4.10	1.1	.275	4255	.55	8214	.825	11.976

***To order, specify Item Number in following fashion:**

Prefix	D	G	T
WZ8050			

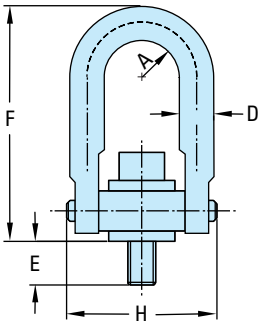
e.g. WZ8050 160 082 090
WZ8050 500 254 300

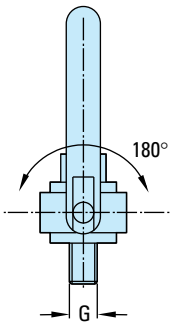
Indicates items in stock.

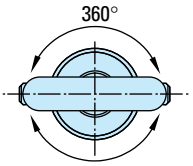
Indicates 2-3 week delivery.

Hoist rings

- Anillos elevadores
- Anéis de içamento articulados
- Anneaux de levage articulés
- Sicherheitsringschrauben







Mat. 50 Cr V4 DIN 2093 Max. 300°

ITEM NUMBER	A	D	E	F	G	H	TL* (Kgm)	P* (Kg)	W* (Kg)	REPLACEMENT KIT ITEM NUMBER	REPLACEMENT KIT G
SHM 0001	10.9	9.7	12.5	67.8	M8 x 1.25	46.7	1.0	400	0.17	SHRM 0001	M8 x 1.25
SHM 0002	10.9	9.7	17.5	67.8	M10 x 1.50	46.7	1.7	450	0.17	SHRM 0002	M10 x 1.50
SHM 0003	22.4	19.0	19.0	121.4	M12 x 1.75	89.4	3.8	1050	1.08	SHRM 0003	M12 x 1.75
SHM 0004	22.4	19.0	29.0	121.4	M16 x 2.00	89.4	8.2	1900	1.12	SHRM 0004	M16 x 2.00
SHM 0005	22.4	19.0	34.0	121.4	M20 x 2.50	89.4	13.6	2150	1.19	SHRM 0005	M20 x 2.50
SHM 0006	35.6	25.4	37.0	165.6	M24 x 3.00	130.6	31.0	4200	3.10	SHRM 0006	M24 x 3.00
SHM 0007	44.5	31.7	41.9	221.7	M30 x 3.50	165.1	60.0	7000	6.30	SHRM 0007	M30 x 3.50
SHM 0009	57.2	44.4	63.5	316.7	M36 x 4.00	217.2	100.0	11000	15.50	SHRM 0009	M36 x 4.00
SHM 0010	57.2	44.4	68.0	316.7	M42 x 4.50	217.2	100.0	12500	16.00	SHRM 0010	M42 x 4.50
SHM 0011	57.2	44.4	82.4	316.7	M48 x 5.00	217.2	100.0	13500	16.80	SHRM 0011	M48 x 5.00
SHM 0012	76.2	57.15	101.6	419.1	M64 x 6.00	297.6	290.0	22500	40.0	SHRM 0012	M64 x 6.00

FEATURES
- Pivots and swivels to compensate for pitch, roll and sway when lifting heavy or unbalanced loads.
- High-strength alloy steel with minimum tensile strength of 1,250 MPa (125 kg/mm²).
- Certified heat treatment with 100% Magnaflux inspection.
- Corrosion-resistant plating.
- Maximum operating temperature 200°C.
- Safety factor is 5 times the rated load in any direction.

***NOTE**
- Standard tolerance ± 0.8 mm.
- E = the use of spacers between bushing flange and mounting surface is not recommended as this will reduce the safety load rating.
- TL = recommended torque load + 25% - 0.
- P = rated.
- W = weight.

CARACTERÍSTICAS
- Gira y pivotea para compensar la inclinación, el rodaje y la oscilación al levantar cargas pesadas o sin equilibrio.
- Aleación de acero de gran resistencia con fuerza elástica mínima de 1,250 MPa (125 kg/mm²).
- Tratamiento de calor certificado con inspección Magnaflux del 100%.
- Enchapado resistente a la corrosión.
- Temperatura máxima de operación: 200°C.
- El factor de seguridad es 5 veces la carga calificada en cualquier dirección.

***NOTA**
- Tolerancia estándar ±0.8 mm.
- E = el uso de espaciadores entre el reborde del cojinete y la superficie de montaje no se recomienda ya que esto reducirá la calificación de seguridad de la carga.
- TL = carga de torsión recomendada + 25% - 0.
- P = calificada.
- W = peso.

MERKMALE
- Gleichmäßiges anheben von schweren oder einseitigen Lasten durch Drehgelenke und Abstandsausgleichung. Keine Abweichung nach der schweren Lastseite.
- Legierter Spezialstahl mit min. Streckgrenze von 1.250 MPa (125 Kg/mm²)
- Beglaubigte Wärmebehandlung mit 100% iger Magnaflux.
- Kontrolle Korrosionsbeständiger Oberflächenschutz.
- Alle Materialangaben gelten bis zu einer Temp. bis max. 200°C.
- Alle Heberinge sind in allen Richtungen mit 5-facher Sicherheit ausgelegt.

***BEMERKUNGEN**
- Allgemeine Toleranzen ± 0.8 mm.
- E = zwischen Flansch und Montageoberfläche keine Distanzscheibe einlegen: dadurch wird die Sicherheit der Hebeleistung reduziert.
- TL = empfohlene Drehmomentbelastung.
- P = Nennlast.
- W = Gewicht.

CARACTÉRISTIQUES
- Ils pivotent et tournent pour amortir le balancement des charges lourdes ou deséquilibrées. Résistent aux charges latérales.
- Acier allié avec une résistance de 1.250 MPa (125 kg/mm²).
- Une trempe garantie par une inspection Magnaflux de 100 %.
- Résiste à la corrosion grâce à un traitement de surface.
- Température de fonctionnement 200°C.
- Coefficient de sécurité 5:1 quelle que soit l'orientation de la charge.

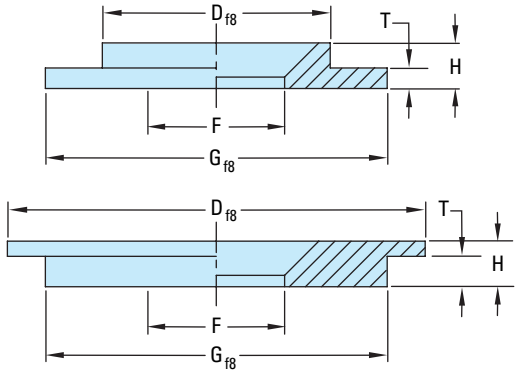
***NOTE**
- Tolérance standard ± 0.8 mm.
- E = L'emploi d'une rondelle de réglage entre l'anneau et la surface d'appui est à déconseiller. Elle réduirait le coefficient de sécurité.
- TL = couple de serrage + 25 % - 0.
- P = charge maximum.
- W = Poids en kg.

CARACTERÍSTICAS
- Eles se articulam e giram para compensar a inclinação, rolagem e balanço de cargas pesadas ou desequilibradas.
- Liga de aço de alta resistência de 1.250 MPa (125 kg/mm²).
- Tratamento a calor, certificado por inspeção 100 % Magnaflux.
- Revestimento resistente à corrosão.
- Temperatura máxima operacional de 200°C.
- Coeficiente de segurança de 5 vezes a carga nominal, em qualquer direção.

***NOTA**
- Tolerância padrão: ± 0.8 mm.
- E = não se recomenda o uso de espaçadores entre o flange da bucha e a superfície de montagem, pois isto reduzirá o valor da carga nominal de segurança.
- TL = carga recomendada de torque + 25 % - 0.
- P = carga nominal.
- W = peso.

Locating rings

- Anillos de localización
- Anéis de localização
- Rondelles de placement
- Platzringe



KEY

F = Inner diameter
D = Platen-side diameter
G = Mold-side diameter
H = Overall height
T = Mold-side step height

Mat. 1.7130

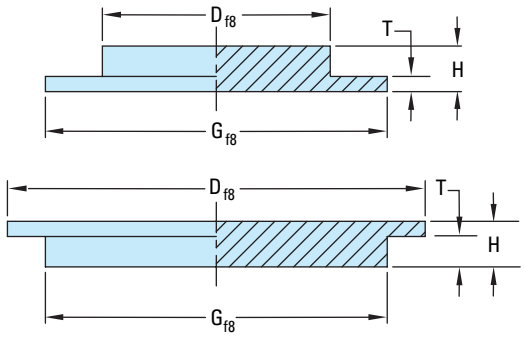
ITEM PREFIX*	G	F	D	H					
				08.0	12.0	15.0	17.0	19.0	20.5
				T					
				4	4	7	9	11	12.5
R21	90	36	060						
	90	36	080						
	90	36	100						
	90	36	110		⚡		⚡		
	90	36	120		⚡	⚡	⚡	⚡	⚡
	90	36	160						
	90	36	175						

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

***To order, specify Item Number in following fashion:**

Prefix	D	H	
R21			e.g. R21 120 170 R21 060 120

Locating Ring (Solid)



KEY

D = Platen-side diameter
G = Mold-side diameter
H = Overall height
T = Mold-side step height

Mat. 1.7130

ITEM PREFIX*	G	D	H					
			08.0	12.0	15.0	17.0	19.0	20.5
			T					
			4	4	7	9	11	12.5
R20	90	060						
	90	080						
	90	100						
	90	110		⚡		⚡		
	90	120						
	90	125		⚡	⚡	⚡	⚡	⚡
	90	160						
	90	175						

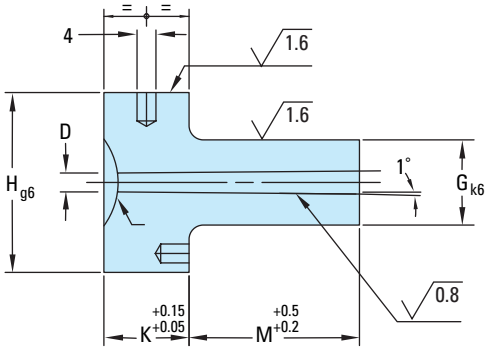
***To order, specify Item Number in following fashion:**

Prefix	D	H	
R20			e.g. R20 120 170 R20 060 120

⚡ Indicates items in stock.
Indicates 2-3 week delivery.

Sprue bushings – hardened

- Cojinetes de tapón – endurecidos
- Buchas de canal – temperadas
- Buses d'injection – trempé
- Angießbuchsen – gehärtet



KEY

D = Sprue orifice diameter
G = Outer diameter
H = Head diameter
K = Top clamp plate thickness
M = Cavity plate thickness

R = No Radius

Mat. 1.2826 54 HRc

Refer to Appendix E for surface finish definitions and Appendix F for fit tolerancing.

ITEM PREFIX*	D	G	H	K	M							
					022	027	036	046	056	076	096	116
R74	2.5	12	28	13	⚡	⚡	⚡	⚡				
	3.5	12	28	13		⚡	⚡	⚡	⚡			
	3.0	18	38	18				⚡	⚡	⚡	⚡	
	4.0	18	38	18					⚡	⚡	⚡	⚡

***To order, specify Item Number in following fashion:**

Prefix	G	M	D	
R74				e.g. R74 12 022 25 R74 18 076 30

R = 15.5mm Radius

Mat. 1.2826 54 HRc

ITEM PREFIX*	D	G	H	K	M							
					022	027	036	046	056	076	096	116
R76	2.5	12	28	13								
	3.5	12	28	13			⚡	⚡	⚡			
	3.0	18	38	18								
	4.0	18	38	18					⚡	⚡	⚡	⚡

***To order, specify Item Number in following fashion:**

Prefix	G	M	D	Suffix	
R76				155	e.g. R76 12 022 25 155 R76 18 096 40 155

R = 40.0mm Radius

Mat. 1.2826 54 HRc

ITEM PREFIX*	D	G	H	K	M							
					022	027	036	046	056	076	096	116
R78	2.5	12	28	13								
	3.5	12	28	13		⚡	⚡	⚡	⚡			
	3.0	18	38	18				⚡	⚡	⚡	⚡	
	4.0	18	38	18					⚡	⚡	⚡	⚡

***To order, specify Item Number in following fashion:**

Prefix	G	M	D	Suffix	
R78				400	e.g. R78 12 022 25 400 R78 18 116 40 400

⚡ Indicates items in stock.

Indicates 2-3 week delivery.

Appendix A:
Definitions

Brinell Hardness

Brinell hardness can be defined as the amount of force applied by a hard object, such as a steel ball, divided by the area of the indentation that the ball makes in the material. The output is read as a pressure (N/mm^2, Kgf/m^2, PSI).

Rockwell Hardness

The Rockwell hardness test is based on the differential in the depth of indentation produced on a sample's surface by a primary ("minor") and secondary ("major") load and a specific sized indentor or "penetrator." The difference in penetration depth between the two loads provides the measure of the hardness. The output would be read as a distance (mm, inch). There are several Rockwell scales for different ranges of hardness. The B scale (RHB) is used for soft metals and utilizes a steel ball as the penetrator, while the C scale (RHC) is used for hard metals and utilizes a cone-shaped diamond as the penetrator. Rockwell hardness numbers are not proportional to Brinell hardness readings.

Vickers Hardness

The Vickers hardness test method differs from the Rockwell (RHC) test method by using a square-based diamond pyramid penetrator, and the hardness number is equal to the load divided by the product of the lengths of the diagonals of the square impression. Vickers hardness is the most accurate test method for very hard materials and can be used on thin sheets of material. The output would not be a pressure value since the load is not divided by the area of the indentation.

Tensile Strength

Tensile strength can be defined as the quantity of stress required to overcome a material's resistance to structural failure. Tensile strength is read as a stress or pressure value (N/mm^2, Kgf/m^2, PSI).

Bending Stiffness

Bending stiffness generally refers to the resistance a material has to bending or deformation. The value for stiffness is defined as force divided by the length (N/mm, Kgf/m, lbs/in).

Appendix B:
Hardness Chart

Brinell Hardness BHN	Brinell Hardness BHN	Vickers Hardness HV	Rockwell Hardness HRA	Rockwell Hardness HRB	Rockwell Hardness HRc	Shore Hardness HS
10 mm ball, 3000 kgf load		(F=>98N)	60kgf load	100kgf load	150kgf load	
Standard ball ($0.102*F/D^2 = 30N/mm^2$) F = test force in N D = dia. ball in mm	Tungsten-Carbide ball ($0.102*F/D^2 = /mm^2$) 30N F = test force in N D = dia. ball in mm	(Also known as Firth Diamond hardness number)	brale penetrator	1/16 inch ball (Values in brackets are not contained in the normal definition range for hardness checking, but are often used in a comparable measure)	brale penetrator	
86		90				
95		100				
105		110				
114	111	120		65.7		
124	121	130		69.8		
133	131	140		74		
143	143	150		78.7	22	
152	152	160		81.7	0	24
162	162	170		85	3	25
171	171	180		87.1	6	26
181	181	190		89.5	8.5	28
190	190	200		91.5	11	29
200	200	210		93.4	13.4	30
209	209	220		95	15.7	32
219	219	230		96.7	18	33
228	228	240	60.7	98.1	20.3	34
238	238	250	61.6	99.5	22.2	36
247	247	260	62.4	(101)	24	37
256	256	270	63.1	(102)	25.6	38
265	265	280	63.8	(103.5)	27.1	40
275	275	290	64.5	(104.5)	28.5	41
285	284	300	65.2	(105.5)	29.8	42
304	303	320	66.4	(107)	32.2	45
323	322	340	67.6	(108)	34.4	47
342	341	360	68.7	(109)	36.6	50
361	360	380	69.8	(110)	38.8	52
380	379	400	70.8		40.8	55
399	397	420	71.8		42.7	57
418	415	440	74.8		44.5	59
437	433	460	73.6		46.1	62
(456)	452	480	74.5		47.7	64
(475)	471	500	74.9		49.1	66
(494)	488	520	76.1		50.5	67
(513)	507	540	76.7		51.7	69
(532)	525	560	77.4		53	71
(551)	545	580	78		54.1	72
(570)	564	600	78.6		55.2	74
(589)		620				
(608)		640				
	660					
	638	680	80.8		59.2	
	653	700	81.2		60	
	670	720	81.8		61	
	682	740	82.2		61.7	
	684	760	82.2		61.8	
	698	780	82.6		62.5	
	710	800	83		63.3	
	722	840	83.4		64	
	745	880	84.1		65.3	
	767	920	84.7		66.4	

Appendix C: Tensile Strength

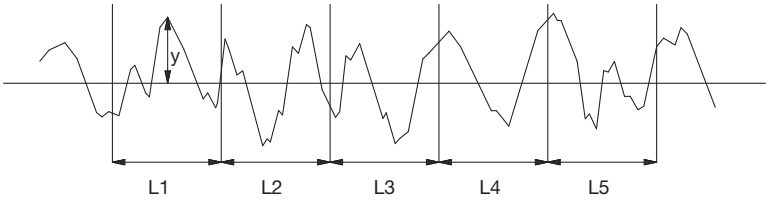
Tensile Strength							
Austenitic stainless steel	**Austenitic** stainless steel	**Austenitic** stainless steel	**Chromium** stainless steel	**Chromium** stainless steel	**Chromium** stainless steel	**Plain Carbon** and low alloy and/or work hardened steel	**Plain Carbon** and low alloy and/or work hardened steel
[kgf/mm^2] ($0.102*F/D^2 = 30N/mm^2$) F = test force in D = dia. ball in mm	[N/mm^2]	[PSI] (approximate)	[kgf/mm^2] ($0.102*F/D^2 = 30N/mm^2$) F = test force in N D = dia. ball in mm	[N/mm^2]	[PSI] (approximate)	[m^2] N/m ($0.102*F/D^2 = 30N/mm^2$) F = test force in N D = dia. ball in mm	[PSI] (approximate)
						285	41,334
						320	46,410
						350	50,761
						385	55,837
						415	60,188
						450	65,264
50	490	71,115	50	490	71,115	480	69,615
56	549	79,649	53	520	75,382	510	73,966
62	608	88,183	59	579	83,916	545	79,042
62	608	88,183	59	579	83,916	575	83,393
68	667	96,716	65	637	92,450	610	88,470
68	667	96,716	65	637	92,450	640	92,820
75	736	106,673	71	696	100,983	675	97,897
75	736	106,673	71	696	100,983	705	102,248
80	785	113,784	78	765	110,939	740	107,324
80	785	113,784	78	765	110,939	770	111,675
85	834	120,896	81	794	115,206	800	116,026
88	863	125,162				835	121,102
91	892	129,429	88	863	125,162	865	125,453
94	922	133,696				900	130,529
97	951	137,963	96	941	136,541	930	134,880
100	981	142,230				965	139,956
109	1,069	155,031	106	1,040	150,764	1,030	149,383
118	1,157	167,831	113	1,108	160,720	1,095	158,810
127	1,245	180,632	120	1,177	170,676	1,155	167,512
136	1,334	193,433	127	1,245	180,632	1,220	176,939
145	1,422	206,234	134	1,314	190,588	1,290	187,091
156	1,530	221,879				1,350	195,793
167	1,638	237,524				1,420	205,945
178	1,746	253,169				1,485	215,372
189	1,853	268,815				1,555	225,525
200	1,961	284,460				1,630	236,402
209	2,050	297,261				1,700	246,554
218	2,138	310,061				1,775	257,432
227	2,226	322,862				1,845	267,584
236	2,314	335,663				1,920	278,461
245	2,403	348,464				1,995	289,339
						2,070	300,216
						2,145	311,094

Steel Designation					
1	2	3	4	5	6
Austenitic Stainless Steel [AISI]	**Chromium Stainless Steel** (Martensitic and Ferritic) [AISI]	**Plain Carbon Steel** [AISI]	**Low Alloy Carbon Steel** [AISI]	**Cold Work Tool Steel** (work hardened) [AISI]	**Hot Work Tool Steel** (work hardened) [AISI]
201	410	1000 series	4000 series	A2	H10
203	416	5061	5000 series	A3	H11
205	420	5062	6000 series	A4	H12
301	429	5063	8000 series	A5	H13
302	430		9000 series	A6	H14
303	431			A7	H19
304	434			A8	H21
305	436			A9	H22
307	439			A10	H23
308	440			D2	H24
309	442			D3	H25
310	444			D4	H26
314	446			D5	H40
316				D7	H41
317					H42
318					H43
321					
329					
330					
332					
334					
347					
348					
384					
385					

Appendix E:
Surface Texture – Parameter Definitions

Surface texture is quantified by parameters that relate to certain characteristics of texture. The texture is measured by examining equal and consecutive sample lengths along a part. the assessments may be filtered or unfiltered.

Li = sample of length
i = number of samples
y = height of peak or depth of valley in surface at point of measurement



For filtered and unfiltered assessments, the mean (average) line in a texture profile is determined by a least squares straight line. The texture profile will deviate around the mean line with peaks "p" and valleys "v."

The parameter Ra defines the arithmetic mean of departures of the profile from the mean line. Ra can also be defined as the arithmetical average of the deviations relative to an ideal surface. Ra would be measured in either microinches or micrometers, and is the most common form of surface texture measurement. The arithmetical definition of Ra is as follows:

$$Ra = \frac{1}{j \times n} \sum_{Li=1}^{Li=j} \left(\sum_{i=1}^{i=n} \left| y(i) \right| \right) (Li)$$

For filtered assessments:
n = 230
j = 2 (min value) to 5 (max value)

For unfiltered assessments:
n = 1000
j = 1

Rt defines the maximum roughness, and refers to the maximum peak to valley height of the profile in the assessment length (for an unfiltered profile). The parameter Rti would refer to the maximum peak to valley height of the profile in one specific sampling length.

Rtm is the mean of all the Rt(i) values obtained in an assessment. Rtm is also known as Rz(DIN) under DIN specifications. Rtm can be arithmetically defined as follows:

$$Rtm = Rz(DIN) = \frac{1}{j} \sum_{i=1}^{i=j} Rt(i)$$

Example: A component has a Rz(DIN) surface texture specification of 4 micrometers. The finish would be listed as an Rz4 finish on the component drawing.

The ISO specification for Rz differs from the DIN specification in that Rz is the ISO 10 point height parameter, which defines the average height difference between only the five highest peaks and the five lowest valleys within the sampling length. Rz can be arithmetically defined as follows:

$$Rz(ISO) = \frac{(yp1 + yp2 + yp3 + yp4 + yp5) - (yv1 + yv2 + yv3 + yv4 + yv5)}{5}$$

$$Rz(ISO) = \frac{1}{5} \left(\sum_{i=1}^{i=5} ypi - \sum_{i=1}^{i=5} yvi \right)$$

Appendix F:
Tables for Determining Metric Tolerances

Table 1: Description of Fits

Table 1 is pulled from the ANSI metric tolerances section of the machinists' handbook, which conforms to the ISO and DIN tolerances for hole basis and shaft basis fits. Table 1 provides an overview of the hole basis and shaft basis fits that make up clearance fit, transition fit and interference fit combinations.

	ISO SYMBOL			
	HOLE BASIS	**SHAFT BASIS**		
CLEARANCE FITS	H11/c11	C11/h11	Loose running fit	For wide commercial tolerances or allowances on external members.
	H9/d9	D9/h9	Free running fit	Not for use where accuracy is essential, but good for large temperature variations, high running speeds, or heavy journal pressures.
	H8/f7	F8/h7	Close running fit	For running on accurate machines and for accurate location at moderate speeds and journal pressures.
	H7/g6	g7/h6	Sliding fit	Not intended to run freely, but to move and turn freely and locate accurately.
	H7/h6	H7/h6	Locational clearance fit	Provides snug fit for locating stationary parts; but can be freely assembled and disassembled.
TRANSITION FITS	H7/k6	K7/h6	Locational transition fit	For accurate location, a compromise between clearance and interference.
	H7/n6	N7/h6	Locational transition fit	For more accurate location where greater interference is permissible.
INTERFERENCE FITS	H7/p6	P7/h6	Locational interference fit	For parts requiring rigidity and alignment with prime accuracy of location but without special bore pressure requirements.
	H7/s6	S7/h6	Medium drive fit	For ordinary steel parts or shrink fits on light sections, the tightest fit usable with cast iron.
	H7/u6	U7/h6	Force fit	Suitable for parts which can be highly stressed or for shrink fits where the heavy pressing forces required are impractical.

Excerpt from *Machinists' Handbook,* pg. 661, 25 Ed., Industrial Press.
Note: The H7/p6 Hole Basis fit is a transition fit for basic sizes in range from 0 through 3 mm.

Appendix F:
Tables for Determining Metric Tolerances

Table 2: Commonly Used Hole-Basis System of Fits

Table 2 shows closer detail on the hole-basis system of fits than Table 1. When using the hole-basis system of fits, the smallest diameter in the hole tolerance range is fixed to the zero line (basic nominal hole size or diameter), and the clearance between the shaft and hole extends below the zero line, or negative relative to the basic nominal hole size.

BASIC HOLES	LETTER SYMBOLS AND GRADE NUMBERS OF SHAFTS																
	CLEARANCE FITS						TRANSITION FITS				INTERFERENCE FITS						
	b	c	d	e	f	g	h	js	k	m	n	p	r	s	t	u	x
H5						4	4	4	4	4							
H6						5	5	5	5	5							
					6	6	6	6	6	6	6*	6*					
H7				6	6	6	6	6	6	6	6	6*	6*	6	6	6	6
				7	7	7	7	7	7	7	7	7*	7*	7	7	7	7
					7		7										
H8				8	8		8										
			9	9													
H9			8	8			8										
		9	9	9			9										
H10	9	9	9														

*Exceptions occur in some steps of dimensions.

Table 3: Commonly Used Shaft-Basis System of Fits

Table 3 shows closer detail on the shaft-basis system of fits than Table 1. When using the shaft-basis system of fits, the largest diameter of the shaft tolerance range is fixed to the zero line (basic nominal shaft size or diameter), and the clearance between the shaft and hole extends above the zero line, or positive relative to the basic shaft size.

BASIC SHAFTS	LETTER SYMBOLS AND GRADE NUMBERS OF HOLES																
	CLEARANCE FITS						TRANSITION FITS				INTERFERENCE FITS						
	B	C	D	E	F	G	H	Js	K	M	N	P	R	S	T	U	X
h4							5	5	5	5							
h5							6	6	6	6	6*	6					
h6					6	6	6	6	6	6	6	6*					
				7	7	7	7	7	7	7	7	7*	7	7	7	7	7
h7				7	7	7	7	7	7	7	7	7	7*	7			
					8		8										
h8			8	8	8		8										
			9	9			9										
h9			8	8			8										
		9	9	9			9										
	10	10	10														

*Exceptions occur in some steps of dimensions.

Appendix F:
Tables for Determining Metric Tolerances

Table 4: IT Standard Tolerances

Table 4 details the ISO-basic tolerances (International Tolerance Grades, or, "IT") which apply to all linear sizes (external and internal sizes, diameters, lengths, widths and thicknesses). An IT-grade number establishes the magnitude of the tolerance zone, while the tolerance position letter determines where the tolerance zone is in relation to the zero line. The combination of tolerance position letter (A-X, a-x) and IT-grade number (01–8) creates the overall tolerance symbol (i.e., F8/h7 when using the shaft-basis system of fits).

For nominal size range up to 500 mm according to DIN 7151/ISO 286, and for nominal size range over 500 mm, according to DIN 7172/ISO 286.

	ITEMS IN MM		IT STANDARD TOLERANCES (units in 0.001 mm)																			
	OVER	TO	IT01	IT0	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16	IT17	IT18
NOMINAL SIZE RANGE	0	3	0.3	0.5	0.8	1.2	2	3	4	6	10	14	25	40	60	100	140	250	400	600	–	–
	3	6	0.4	0.6	1	1.5	2.5	4	5	8	12	18	30	48	75	120	180	300	480	750	–	–
	6	10	0.4	0.6	1	1.5	2.5	4	6	9	15	22	36	58	90	150	220	360	580	900	1500	–
	10	18	0.5	0.8	1.2	2	3	5	8	11	18	27	43	70	110	180	270	430	700	1100	1800	2700
	18	30	0.6	1	1.5	2.5	4	6	9	13	21	33	52	84	130	210	330	520	840	1300	2100	3300
	30	50	0.6	1	1.5	2.5	4	7	11	16	25	39	62	100	160	250	390	620	1000	1600	2500	3900
	50	80	0.8	1.2	2	3	5	8	13	19	30	46	74	120	190	300	460	740	1200	1900	3000	4600
	80	120	1	1.5	2.5	4	6	10	15	22	35	54	87	140	220	350	540	870	1400	2200	3500	5400
	120	180	1.2	2	3.5	5	8	12	18	25	40	63	100	160	250	400	630	1000	1600	2500	4000	6300
	180	250	2	3	4.5	7	10	14	20	29	46	72	115	185	290	460	720	1150	1850	2900	4600	7200
	250	315	2.5	4	6	8	12	16	23	32	52	81	130	210	320	520	810	1300	2100	3200	5200	8100
	315	400	3	5	7	9	13	18	25	36	57	89	140	230	360	570	890	1400	2300	3600	5700	8900
	400	500	4	6	8	10	15	20	27	40	63	97	155	250	400	630	970	1550	2500	4000	6300	9700
	500	630	–	–	–	–	–	–	–	–	70	110	175	280	440	700	1100	1750	2800	4400	–	–
	630	800	–	–	–	–	–	–	–	–	80	125	200	320	500	800	1250	2000	3200	5500	–	–
	800	1000	–	–	–	–	–	–	–	–	90	140	230	360	550	900	1400	2300	3600	5600	–	–

Table 5: Fundamental Deviations of Holes and Shafts

Table 5 details fundamental deviations between holes and shafts, and is provided for reference.

HOLES	GRADE		IT6 TO IT16													
	DIVISIONS		FUNDAMENTAL DEVIATIONS (LOWER DEVIATIONS)						FUNDAMENTAL DEVIATIONS (UPPER DEVIATIONS)							
	LETTER SYMBOLS		D	E	F	G	H	Js	K	M	N	P	R	S	T	U
	SIGNS		+	+	+	+				–	–	–	–	–	–	–
	ABOVE	UP TO														
	500	560	260	145	76	22	0	Deviations (+/-) IT/2	0	26	44	78	150	280	400	600
	560	630											155	310	450	660
	630	710	290	160	80	24	0		0	30	50	88	175	340	500	740
	710	800											185	380	560	840
	800	900	320	170	86	26	0		0	34	56	100	210	430	620	940
	900	1000											220	470	680	1050
	1000	1120	350	195	98	28	0		0	40	66	120	250	520	780	1150
	1120	1250											260	580	840	1300
	1250	1400	390	220	110	30	0		0	48	78	140	300	640	960	1450
	1400	1600											330	720	1050	1600
	1600	1800	430	240	120	32	0		0	58	92	170	370	820	1200	1850
	1800	2000											400	920	1350	2000
	2000	2240	480	260	130	34	0		0	68	110	195	440	1000	1500	2300
	2240	2500											460	1100	1650	2500
	2500	2800	520	290	145	38	0		0	76	135	240	550	1250	1900	2900
	2800	3150											580	1400	2100	3200
	ABOVE	UP TO														
SHAFTS	SIGNS		–	–	–	–				+	+	+	+	+	+	+
	LETTER SYMBOLS		d	e	f	g	h	js	k	m	n	p	r	s	t	u
	DIVISIONS		FUNDAMENTAL DEVIATIONS (UPPER DEVIATIONS)						FUNDAMENTAL DEVIATIONS (LOWER DEVIATIONS)							
	GRADE		IT6 TO IT16													

Appendix F: Tables for Determining Metric Tolerances

Table 6: Tolerances for Inside Dimensions (Holes)

Table 6 details tolerances for inside dimensions (holes) based relative to the tolerance symbol. Upper and lower values are provided as either positive or negative (or zero) values relative to the nominal size chosen. Pick the range in which the desired nominal value falls into, and then either add or subtract the tolerances to find the upper and lower tolerance range for the desired nominal size.

	UNITS IN MM		TOLERANCES FOR INSIDE DIMENSIONS (HOLES) (Units in 0.001 mm)																		
	OVER	TO	A11	B8	B11	C11	D9	D10	D11	E8	E9	F6	F7	F8	G6	G7	H5	H6	H7	H8	H9	H10
NOMINAL SIZE RANGE	0	1	–	–	–	+120	+45	+60	+80	+28	+39											
			–	–	–	+60	+20	+20	+20	+14	+14	+12	+16	+20	+8	+12	+4	+6	+10	+14	+25	+40
	1	3	+330	+154	+200	+120	+45	+60	+80	+28	+39											
			+270	+140	+140	+60	+20	+20	+20	+14	+14	+6	+6	+6	+2	+2	0	0	0	0	0	0
	3	6	+345	+158	+215	+145	+60	+78	+105	+38	+50	+18	+22	+28	+12	+16	+5	+8	+12	+18	+30	+48
			+270	+140	+140	+70	+30	+30	+30	+20	+20	+10	+10	+10	+4	+4	0	0	0	0	0	0
	6	10	+370	+172	+240	+170	+76	+98	+130	+47	+61	+22	+28	+35	+14	+20	+6	+9	+15	+22	+36	+58
			+280	+150	+150	+80	+40	+40	+40	+25	+25	+13	+13	+13	+5	+5	0	0	0	0	0	0
	10	14																				
			+400	+177	+260	+205	+93	+120	+160	+59	+75	+27	+34	+43	+17	+24	+8	+11	+18	+27	+43	+70
	14	18	+290	+150	+150	+95	+50	+50	+50	+32	+32	+16	+16	+16	+6	+6	0	0	0	0	0	0
	18	24																				
			+430	+193	+290	+240	+117	+149	+195	+73	+92	+33	+41	+53	+20	+28	+9	+13	+21	+33	+52	+84
	24	30	+300	+160	+160	+110	+65	+65	+65	+40	+40	+20	+20	+20	+7	+7	0	0	0	0	0	0
	30	40	+470	+209	+330	+280																
			+310	+170	+170	+120	+142	+180	+240	+89	+112	+41	+50	+64	+25	+34	+11	+16	+25	+39	+62	+100
	40	50	+480	+219	+340	+290	+80	+80	+80	+50	+50	+25	+25	+25	+9	+9	0	0	0	0	0	0
			+320	+180	+180	+130																
	50	65	+530	+236	+380	+330																
			+340	+190	+190	+140	+174	+220	+290	+106	+134	+49	+60	+76	+29	+40	+13	+19	+30	+46	+74	+120
	65	80	+550	+246	+390	+340	+100	+100	+100	+60	+60	+30	+30	+30	+10	+10	0	0	0	0	0	0
			+360	+200	+200	+150																
	80	100	+600	+274	+440	+390																
			+380	+220	+220	+170	+207	+260	+340	+126	+159	+58	+71	+90	+34	+47	+15	+22	+35	+54	+87	+140
	100	120	+630	+294	+460	+400	+120	+120	+120	+72	+72	+36	+36	+36	+12	+12	0	0	0	0	0	0
			+410	+240	+240	+180																
	120	140	+710	+323	+510	+450																
			+460	+260	+260	+200																
	140	160	+770	+343	+530	+460	+245	+305	+395	+148	+185	+68	+83	+106	+39	+54	+18	+25	+40	+63	+100	+160
			+520	+280	+280	+210	+145	+145	+145	+85	+85	+43	+43	+43	+14	+14	0	0	0	0	0	0
	160	180	+830	+373	+560	+480																
			+580	+310	+310	+230																
	180	200	+950	+412	+630	+530																
			+660	+340	+340	+240																
	200	225	+1030	+452	+670	+550	+285	+355	+460	+172	+215	+79	+96	+122	+44	+61	+20	+29	+46	+72	+115	+185
			+740	+380	+380	+260	+170	+170	+170	+100	+100	+50	+50	+50	+15	+15	0	0	0	0	0	0
	225	250	+1110	+492	+710	+570																
			+820	+420	+420	+280																
	250	280	+1240	+561	+800	+620																
			+920	+480	+480	+300	+320	+400	+510	+191	+240	+88	+108	+137	+49	+69	+23	+32	+52	+81	+130	+210
	280	315	+1370	+621	+860	+650	+190	+190	+190	+110	+110	+56	+56	+56	+17	+17	0	0	0	0	0	0
			+1050	+540	+540	+330																
	315	355	+1560	+689		+720																
			+1200	+600	+600	+360	+350	+440	+570	+214	+265	+98	+119	+151	+54	+75	+25	+36	+57	+89	+140	+230
	355	400	+1710	+769	+1040	+760	+210	+210	+210	+125	+125	+62	+62	+62	+18	+18	0	0	0	0	0	0
			+1350	+680	+680	+400																
	400	450	+1900	+857	+1160	+840																
			+1500	+760	+760	+440	+385	+480	+630	+232	+290	+108	+131	+165	+60	+83	+27	+40	+63	+97	+155	+250
	450	500	+2050	+937	+1240	+880	+230	+230	+230	+135	+135	+68	+68	+68	+20	+20	0	0	0	0	0	0
			+1650	+840	+840	+480																

Table 6: Tolerances for Inside Dimensions (Holes), continued

NOMINAL SIZE RANGE	UNITS IN MM		TOLERANCES FOR INSIDE DIMENSIONS (HOLES) (Units in 0.001 mm)																		
	OVER	TO	H11	H12	H13	J6	J7	J8	K6	K7	K8	M6	M7	M8	N6	N7	N8	R7	JS6	JS7	JS8	JS9
	0	1	+60	+100	+140	+2	+4	+6	0	0	0	-2	-2	—	-4	-4	-4	-10	+3	+5	+7	+12.5
	1	3	0	0	0	-4	-6	-8	-6	-10	-14	-8	-12	—	-10	-14	-18	-20	-3	-5	-7	-12.5
	3	6	+75	+120	+180	+5	+6	+10	+2	+3	+5	-1	0	+2	-5	-4	-2	-11	+4	+6	+9	+15
			0	0	0	-3	-6	-8	-6	-9	-13	-9	-12	-16	-13	-16	-20	-23	-4	-6	-9	-15
	6	10	+90	+150	+220	+5	+8	+12	+2	+5	+6	-3	0	+1	-7	-4	-3	-13	+4.5	+7.5	+11	+18
			0	0	0	-4	-7	-10	-7	-10	-16	-12	-15	-21	-16	-19	-25	-28	-4.5	-7.5	-11	-18
	10	14	+110	+180	+270	+6	+10	+15	+2	+6	+8	-4	0	+2	-9	-5	-3	-16	+5.5	+9	+13.5	+21.5
	14	18	0	0	0	-5	-8	-12	-9	-12	-19	-15	-18	-25	-20	-23	-30	-34	-5.5	-9	-13.5	-21.5
	18	24	+130	+210	+330	+8	+12	+20	+2	+6	+10	-4	0	+4	-11	-7	-3	-20	+6.5	+10.5	+16.5	+26
	24	30	0	0	0	-5	-9	-13	-11	-15	-23	-17	-21	-29	-24	-28	-36	-41	-6.5	-10.5	-16.5	-26
	30	40	+160	+250	+390	+10	+14	+24	+3	+7	+12	-4	0	+5	-12	-8	-3	-25	+8	+12.5	+19.5	+31
	40	50	0	0	0	-6	-11	-15	-13	-18	-27	-20	-25	-34	-28	-33	-42	-50	-8	-12.5	-19.5	-31
	50	65	+190	+300	+460	+13	+18	+28	+4	+9	+14	-5	0	+5	-14	-9	-4	-30 -60	+9.5	+15	+23	+37
	65	80	0	0	0	-6	-12	-18	-15	-21	-32	-24	-30	-41	-33	-39	-50	-32 -62	-9.5	-15	-23	-37
	80	100	+220	+350	+540	+16	+22	+34	+4	+10	+16	-6	0	+6	-16	-10	-4	-38 -73	+11	+17.5	+27	+43.5
	100	120	0	0	0	-6	-13	-20	-18	-25	-38	-28	-35	-48	-38	-45	-58	-41 -76	-11	-17.5	-27	-43.5
	120	1400																-48 -88				
	140	160	+250	+400	+630	+18	+26	+41	+4	+12	+20	-8	0	+8	-20	-12	-4	-50 -90	+12.5	+20	+31.5	+50
	160	180	0	0	0	-7	-14	-22	-21	-28	-43	-33	-40	-55	-45	-52	-67	-53 -93	-12.5	-20	-31.5	-50
	180	200																-60 -106				
	200	225	+290	+460	+720	+22	+30	+47	+5	+13	+22	-8	0	+9	-22	-14	-5	-63 -109	+14.5	+23	+36	+57.5
	225	250	0	0	0	-7	-16	-25	-24	-33	-50	-37	-46	-63	-51	-60	-77	-67 -113	-14.5	-23	-36	-57.5
	250	280	+320	+520	+810	+25	+36	+55	+5	+16	+25	-9	0	+9	-25	-14	-5	-74 -126	+16	+26	+40.5	+65
	280	315	0	0	0	-7	-16	-26	-27	-36	-56	-41	-52	-72	-57	-66	-86	-78 -130	-16	-26	-40.5	-65
	315	355	+360	+570	+890	+29	+39	+60	+7	+17	+28	-10	0	+11	-26	-16	-5	-87 -144	+18	+28.5	+44.5	+70
	355	400	0	0	0	-7	-18	-29	-29	-40	-61	-46	-57	-78	-62	-73	-94	-93 -150	-18	-28.5	-44.5	-70
	400	450	+400	+630	+970	+33	+43	+66	+8	+18	+29	-10	0	+11	-27	-17	-6	-103 -166	+20	+31.5	+48.5	+77.5
	450	500	0	0	0	-7	-20	-31	-32	-45	-68	-50	-63	-86	-67	-80	-103	-109 -172	-20	-31.5	-48.5	-77.5

Appendix F: Tables for Determining Metric Tolerances

Table 6: Tolerances for Inside Dimensions (Holes), continued

NOMINAL SIZE RANGE	UNITS IN MM		TOLERANCES FOR INSIDE DIMENSIONS (HOLES) (Units in 0.001 mm)								
	OVER	TO	JS10	JS11	JS12	JS13	JS14	JS15	JS16	JS17	JS18
	0	1	+20 -20	+30 -30	+50 -50	+70 -70	+125 -125	+200 -200	+300 -300	– –	– –
	1	3									
	3	6	+24 -24	+37.5 -37.5	+60 -60	+90 -90	+150 -150	+240 -240	+375 -375	– –	– –
	6	10	+29 -29	+45 -45	+75 -75	+110 -110	+180 -180	+290 -290	+450 -450	+750 -750	– –
	10	14	+35 -35	+55 -55	+90 -90	+135 -135	+215 -215	+350 -350	+550 -550	+900 -900	+1350 -1350
	14	18									
	18	24	+42 -42	+65 -65	+105 -105	+165 -165	+260 -260	+420 -420	+650 -650	+1050 -1050	+1650 -1650
	24	30									
	30	40	+50 -50	+80 -80	+125 -125	+195 -195	+310 -310	+500 -500	+800 -800	+1250 -1250	+1950 -1950
	40	50									
	50	65	+60 -60	+95 -95	+150 -150	+230 -230	+370 -370	+600 -600	+950 -950	+1500 -1500	+2300 -2300
	65	80									
	80	100	+70 -70	+110 -110	+175 -175	+270 -270	+435 -435	+700 -700	+1100 -1100	+1750 -1750	+2700 -2700
	100	120									
	120	1400	+80 -80	+125 -125	+200 -200	+315 -315	+500 -500	+800 -800	+1250 -1250	+2000 -2000	+3150 -3150
	140	160									
	160	180									
	180	200	+92.5 -92.5	+145 -145	+230 -230	+360 -360	+575 -575	+925 -925	+1450 -1450	+2300 -2300	+3600 -3600
	200	225									
	225	250									
	250	280	+105 -105	+160 -160	+260 -260	+405 -405	+650 -650	+1050 -1050	+1600 -1600	+2600 -2600	+4050 -4050
	280	315									
	315	355	+115 -115	+180 -180	+285 -285	+445 -445	+700 -700	+1150 -1150	+1800 -1800	+2850 -2850	+4450 -4450
	355	400									
	400	450	+125 -125	+200 -200	+315 -315	+485 -485	+775 -775	+1250 -1250	+2000 -2000	+3150 -3150	+4850 -4850
	450	500									

Appendix F:
Tables for Determining Metric Tolerances

Table 7: Tolerances for Outside Dimensions (Shafts)

Table 7 details tolerances for outside dimensions (shafts) based relative to the tolerance symbol. Upper and lower values are provided as either positive or negative (or zero) values relative to the nominal size chosen. Pick the range in which the desired nominal value fall into, and then either add or subtract the tolerances to find the upper and lower tolerance range for the desired nominal size.

	UNITS IN MM		TOLERANCES FOR OUTSIDE DIMENSIONS (SHAFTS) (Units in 0.001 mm)																		
	OVER	TO	a11	b8	b11	c11	d9	d10	d11	e8	e9	f6	f7	f8	f9	g5	g6	g7	h4	h5	h6	h7
NOMINAL SIZE RANGE	0	1	—	—	—	-60																
			—	—	—	-120	-20	-20	-20	-14	-14	-6	-6	-6	-6	-2	-2	-2	0	0	0	0
	1	3	-270	-140	-140	-60	-45	-60	-80	-28	-39	-12	-16	-20	-31	-6	-8	-12	-3	-4	-6	-10
			-330	-154	-200	-120																
	3	6	-270	-140	-140	-70	-30	-30	-30	-20	-20	-10	-10	-10	-10	-4	-4	-4	0	0	0	0
			-345	-158	-215	-145	-60	-78	-105	-38	-50	-18	-22	-28	-40	-9	-12	-16	-4	-5	-8	-12
	6	10	-280	-150	-150	-80	-40	-40	-40	-25	-25	-13	-13	-13	-13	-5	-5	-5	0	0	0	0
			-370	-172	-240	-170	-76	-98	-130	-47	-61	-22	-28	-35	-49	-11	-14	-20	-4	-6	-9	-15
	10	14	-290	-150	-150	-95	-50	-50	-50	-32	-32	-16	-16	-16	-16	-6	-6	-6	0	0	0	0
	14	18	-400	-177	-260	-205	-93	-120	-160	-59	-75	-27	-34	-43	-59	-14	-17	-24	-5	-8	-11	-18
	18	24	-300	-160	-160	-110	-65	-65	-65	-40	-40	-20	-20	-20	-20	-7	-7	-7	0	0	0	0
	24	30	-430	-193	-290	-240	-117	-149	-195	-73	-92	-33	-41	-53	-72	-16	-20	-28	-6	-9	-13	-21
	30	40	-310	-170	-170	-120																
			-470	-209	-330	-280	-80	-80	-80	-50	-50	-25	-25	-25	-25	-9	-9	-9	0	0	0	0
	40	50	-320	-180	-180	-130	-142	-180	-240	-89	-112	-41	-50	-64	-87	-20	-25	-34	-7	-11	-16	-25
			-480	-219	-340	-290																
	50	65	-340	-190	-190	-140																
			-530	-236	-380	-330	-100	-100	-100	-60	-60	-30	-30	-30	-30	-10	-10	-10	0	0	0	0
	65	80	-360	-200	-200	-150	-174	-220	-290	-106	-134	-49	-60	-76	-104	-23	-29	-40	-8	-13	-19	-30
			-550	-246	-390	-340																
	80	100	-380	-220	-220	-170																
			-600	-274	-440	-390	-120	-120	-120	-72	-72	-36	-36	-36	-36	-12	-12	-12	0	0	0	0
	100	120	-410	-240	-240	-180	207	-260	-340	-126	-159	-58	-71	-90	-123	-27	-34	-47	-10	-15	-22	-35
			-630	-294	-460	-400																
	120	1400	-460	-260	-260	-200																
			-710	-323	-510	-450																
	140	160	-520	-280	-280	-210	-145	-145	-145	-85	-85	-43	-43	-43	-43	-14	-14	-14	0	0	0	0
			-770	-343	-530	-460	-245	-305	-395	-148	-185	-68	-83	-106	-143	-32	-39	-54	-12	-18	-25	-40
	160	180	-580	-310	-310	-230																
			-830	-373	-560	-480																
	180	200	-660	-340	-330	-240																
			-950	-412	-630	-530																
	200	225	-740	-380	-380	-260	-170	-170	-170	-100	-100	-50	-50	-50	-50	-15	-15	-15	0	0	0	0
			-1030	-452	-670	-550	-285	-355	-460	-172	-215	-79	-96	-122	-165	-35	-44	-61	-14	-20	-29	-46
	225	250	-820	-420	-420	-280																
			-1110	-492	-710	-570																
	250	280	-920	-480	-480	-300																
			-1240	-561	-800	-620	-190	-190	-190	-110	-110	-56	-56	-56	-56	-17	-17	-17	0	0	0	0
	280	315	-1050	-540	-540	-330	-320	-400	-510	-191	-240	-88	-108	-137	-186	-40	-49	-69	-16	-23	-32	-52
			-1370	-621	-860	-650																
	315	355	-1200	-600	-600	-360																
			-1560	-689	-960	-720	-210	-210	-210	-125	-125	-62	-62	-62	-62	-18	-18	-18	0	0	0	0
	355	400	-1350	-680	-860	-400	-350	-440	-570	-214	-265	-98	-119	-151	-202	-43	-54	-75	-18	-25	-36	-57
			-1710	-769	-1040	-760																
	400	450	-1500	-760	-760	-440																
			-1900	-857	-1160	-840	-230	-230	-230	-135	-135	-68	-68	-68	-68	-20	-20	-20	0	0	0	0
	450	500	-1650	-840	-480	-480	-385	-480	-630	-232	-290	-108	-131	-165	-223	-47	-60	-83	-20	-27	-40	-63
			-2050	-937	-1240	-880																

Appendix F:
Tables for Determining Metric Tolerances

Table 7: Tolerances for Outside Dimensions (Shafts), continued

NOMINAL SIZE RANGE	UNITS IN MM		TOLERANCES FOR OUTSIDE DIMENSIONS (SHAFTS) (Units in 0.001 mm)																		
	OVER	TO	h8	h9	h10	h11	j5	j6	j7	k5	k6	k7	k8	m5	m6	m7	n5	n6	n7	r6	js6	js7
	0	1	0	0	0	0	+2	+4	+6	+4	+6	+10	+14	+6	+8	—	+8	+10	+14	+16	+3	+5
	1	3	-14	-25	-40	-60	-2	-2	-4	0	0	0	0	+2	+2	—	+4	+4	+4	+10	-3	-5
	3	6	0	0	0	0	+3	+6	+8	+6	+9	+13	+18	+9	+12	+16	+13	+16	+20	+23	+4	+6
			-18	-30	-48	-75	-2	-2	-4	+1	+1	+1	0	+4	+4	+4	+8	+8	+8	+15	-4	-6
	6	10	0	0	0	0	+4	+7	+10	+7	+10	+16	+22	+12	+15	+21	+16	+19	+25	+28	+4.5	+7.5
			-22	-36	-58	-90	-2	-2	-5	+1	+1	+1	0	+6	+6	+6	+10	+10	+10	+19	-4.5	-7.5
	10	14	0	0	0	0	+5	+8	+12	+9	+12	+19	+27	+15	+18	+25	+20	+23	+30	+34	+5.5	+9
	14	18	-27	-43	-70	-110	-3	-3	-6	+1	+1	+1	0	+7	+7	+7	+12	+12	+12	+23	-5.5	-9
	18	24	0	0	0	0	+5	+9	+13	+11	+15	+23	+33	+17	+21	+29	+24	+28	+36	+41	+6.5	+10.5
	24	30	-33	-52	-84	-130	-4	-4	-8	+2	+2	+2	0	+8	+8	+8	+15	+15	+15	+28	-6.5	-10.5
	30	40	0	0	0	0	+6	+11	+15	+13	+18	+27	+39	+20	+25	+34	+28	+33	+42	+50	+8	+12.5
	40	50	-39	-62	-100	-160	-5	-5	-10	+2	+2	+2	0	+9	+9	+9	+17	+17	+17	+34	-8	-12.5
	50	65	0	0	0	0	+6	+12	+18	+15	+21	+32	+46	+24	+30	+41	+33	+39	+50	+60 +41	+9.5	+15
	65	80	-46	-74	-120	-190	-7	-7	-12	+2	+2	+2	0	+11	+11	+11	+20	+20	+20	+62 +43	-9.5	-15
	80	100	0	0	0	0	+6	+13	+20	+18	+25	+38	+54	+28	+35	+48	+38	+45	+58	+73 +51	+11	+17.5
	100	120	-54	-87	-140	-220	-9	-9	-15	+3	+3	+3	0	+13	+13	+13	+23	+23	+23	+76 +54	-11	-17.5
	120	1400	0	0	0	0	+7	+14	+22	+21	+28	+43	+63	+33	+40	+55	+45	+52	+67	+88 +63	+12.5	+20
	140	160	-63	-100	-160	-250	-11	-11	-18	+3	+3	+3	0	+15	+15	+15	+27	+27	+27	+90 +65	-12.5	-20
	160	180																		+93 +68		
	180	200	0	0	0	0	+7	+16	+25	+24	+33	+50	+72	+37	+46	+63	+51	+60	+77	+106 +77	+14.5	+23
	200	225	-72	-115	-185	-290	-13	-13	-21	+4	+4	+4	0	+17	+17	+17	+31	+31	+31	+109 +80	-14.5	-23
	225	250																		+113 +84		
	250	280	0	0	0	0	+7	+16	+26	+27	+36	+56	+81	+43	+52	+72	+57	+66	+86	+126 +94	+16	+26
	280	315	-81	-130	-210	-320	-16	-16	-26	+4	+4	+4	0	+20	+20	+20	+34	+34	+34	+130 +98	-16	-26
	315	355	0	0	0	0	+7	+18	+29	+29	+40	+61	+89	+46	+57	+78	+62	+73	+94	+144 +108	+18	+28.5
	355	400	-89	-140	-230	-360	-18	-18	-28	+4	+4	+4	0	+21	+21	+21	+37	+37	+37	+150 +114	-18	-28.5
	400	450	0	0	0	0	+7	+20	+31	+32	+45	+68	+97	+50	+63	+86	+67	+80	+103	+166 +126	+20	+31.5
	450	500	-97	-155	-250	-400	-20	-20	-32	+5	+5	+5	0	+23	+23	+23	+40	+40	+40	+172 +132	-20	-31.5

Table 7: Tolerances for Outside Dimensions (Shafts), continued

NOMINAL SIZE RANGE	UNITS IN MM		TOLERANCES FOR OUTSIDE DIMENSIONS (SHAFTS) (Units in 0.001 mm)										
	OVER	TO	js8	js9	js10	js11	js12	js13	js14	js15	js16	js17	js18
	0	1	+7 -7	+12.5 -12.5	+20 -20	+30 -30	+50 -50	+70 -70	+125 -125	+200 -200	+300 -300	– –	– –
	1	3											
	3	6	+9 -9	+15 -15	+24 -24	+37.5 -37.5	+60 -60	+90 -90	+150 -150	+240 -240	+375 -375	– –	– –
	6	10	+11 -11	+18 -18	+29 -29	+45 -45	+75 -75	+110 -110	+180 -180	+290 -290	+450 -450	+750 -750	– –
	10	14	+13.5 -13.5	+21.5 -21.5	+35 -35	+55 -55	+90 -90	+135 -135	+215 -215	+350 -350	+550 -550	+900 -900	+1350 -1350
	14	18											
	18	24	+16.5 -16.5	+26 -26	+42 -42	+65 -65	+105 -105	+165 -165	+260 -260	+420 -420	+650 -650	+1050 -1050	+1650 -1650
	24	30											
	30	40	+19.5 -19.5	+31 -31	+50 -50	+80 -80	+125 -125	+195 -195	+310 -310	+500 -500	+800 -800	+1250 -1250	+1950 -1950
	40	50											
	50	65	+23 -23	+37 -37	+60 -60	+95 -95	+150 -150	+230 -230	+370 -370	+600 -600	+950 -950	+1500 -1500	+2300 -2300
	65	80											
	80	100	+27 -27	+43.5 -43.5	+70 -70	+110 -110	+175 -175	+270 -270	+435 -435	+700 -700	+1100 -1100	+1750 -1750	+2700 -2700
	100	120											
	120	1400	+31.5 -31.5	+50 -50	+80 -80	+125 -125	+200 -200	+315 -315	+500 -500	+800 -800	+1250 -1250	+2000 -2000	+3150 -3150
	140	160											
	160	180											
	180	200	+36 -36	+57.5 -57.5	+92.5 -92.5	+145 -145	+230 -230	+360 -360	+575 -575	+925 -925	+1450 -1450	+2300 -2300	+3600 -3600
	200	225											
	225	250											
	250	280	+40.5 -40.5	+65 -65	+105 -105	+160 -160	+260 -260	+405 -405	+650 -650	+1050 -1050	+1600 -1600	+2600 -2600	+4050 -4050
	280	315											
	315	355	+44.5 -44.5	+70 -70	+115 -115	+180 -180	+285 -285	+445 -445	+700 -700	+1150 -1150	+1800 -1800	+2850 -2850	+4450 -4450
	355	400											
	400	450	+48.5 -48.5	+77.5 -77.5	+125 -125	+200 -200	+315 -315	+485 -485	+775 -775	+1250 -1250	+2000 -2000	+3150 -3150	+4850 -4850
	450	500											

Appendix F: Tables for Determining Metric Tolerances

Table 8: Tolerances for Inside Dimensions (Holes)

Table 8 details tolerances for inside dimensions (holes) based relative to the tolerance symbol. This table works the same way as Table 6, but is pulled from a different source (ANSI standards) and details S7 and U7 fits. Pick the nominal size value that is **closest** to the desired nominal size to determine the required tolerance range relative to the chosen tolerance symbol.

HOLE BASIS FIT		[mm]	Hole:			
Example:	Nominal size:	60	[mm]			
	Size range to be used:	50 to 65		H7	+0.030	(0.030 mm range)
	ISO-Grade No.:	IT7 (hole), IT6 (shaft)	60		–0	
	Tolerance Symbol:	H7/k6	Shaft:			
	Desired Fit:	Locational Transition Fit	[mm]			
This Gives:	Allowance for hole:	0.030 mm		k6	+0.021	(0.019 mm range)
	Allowance for shaft:	0.019 mm	60		+0.002	

	TOLERANCES FOR INSIDE DIMENSIONS (HOLES) (Units in 0.001 mm)					
	PICK CLOSEST VALUE TO DESIRED DIMENSION (Units in mm)	**S7**	**U7**	**PICK CLOSEST VALUE TO DESIRED DIMENSION (Units in mm)**	**S7**	**U7**
NOMINAL SIZE RANGE	1	-14 -24	-18 -28	25	-27 -48	-40 -61
	1.2	-14 -24	-18 -28	30	-27 -48	-40 -61
	1.6	-14 -24	-18 -28	40	-34 -59	-51 -76
	2	-14 -24	-18 -28	50	-34 -59	-61 -86
	2.5	-14 -24	-18 -28	60	-42 -72	-76 -106
	3	-14 -24	-18 -28	80	-48 -78	-91 -121
	4	-15 -27	-19 -31	100	-58 -93	-111 -146
	5	-15 -27	-19 -31	120	-66 -101	-131 -166
	6	-15 -27	-19 -31	160	-85 -125	-175 -215
	8	-17 -32	-22 -37	200	-105 -151	-219 -265
	10	-17 -32	-22 -37	250	-123 -169	-267 -313
	12	-21 -39	-26 -44	300	-150 -202	-330 -382
	16	-21 -39	-26 -44	400	-187 -244	-414 -471
	20	-27 -48	-33 -54	500	-229 -292	-517 -580

Table 9: Tolerances for Outside Dimensions (Shafts)

Table 9 details tolerances for outside dimensions (shafts) based relative to the tolerance symbol. This table works the same way as Table 7, but is pulled from a different source (ANSI standards) and details s6 and u6 fits. Pick the nominal size value that is **closest** to the desired nominal size to determine the required tolerance range relative to the chosen tolerance symbol.

SHAFT BASIS FIT		[mm]	Hole:			
Example:	Nominal size:	24	[mm]			
	Size range to be used:	18 to 30	24	F6	+0.033 +0.020	(0.013 mm range)
	ISO-Grade No.:	IT6				
	Tolerance Symbol:	F6/h6	Shaft:			
	Desired Fit:	Clearance Fit	[mm]			
This Gives:	Allowance for hole:	0.013 mm	24	h6	0 –0.013	(0.013 mm range)
	Allowance for shaft:	0.013 mm				

TOLERANCES FOR OUTSIDE DIMENSIONS (SHAFTS) (Units in 0.001 mm)

NOMINAL SIZE RANGE	PICK CLOSEST VALUE TO DESIRED DIMENSION (Units in mm)	s6	u6	PICK CLOSEST VALUE TO DESIRED DIMENSION (Units in mm)	s6	u6
	1	+20 +14	+24 +18	25	+48 +35	+61 +48
	1.2	+20 +14	+24 +18	30	+48 +35	+61 +48
	1.6	+20 +14	+24 +18	40	+59 +43	+76 +60
	2	+20 +14	+24 +18	50	+59 +43	+86 +70
	2.5	+20 +14	+24 +18	60	+72 +53	+106 +87
	3	+20 +14	+24 +18	80	+78 +59	+121 +102
	4	+27 +19	+31 +23	100	+93 +71	+146 +124
	5	+27 +19	+31 +23	120	+101 +79	+166 +144
	6	+27 +19	+31 +23	160	+125 +100	+215 +190
	8	+32 +23	+37 +28	200	+151 +122	+265 +236
	10	+32 +23	+37 +28	250	+169 +140	+313 +284
	12	+39 +28	+44 +33	300	+202 +170	+382 +350
	16	+39 +28	+44 +33	400	+244 +208	+471 +435
	20	+48 +35	+54 +41	500	+292 +252	+580 +540

Appendix G: Specifications for Tolerances and Fits, and Hole and Shaft Basis Fit Tolerances

Specifications for Tolerances and Fits

All specifications in this guideline are in accordance with the International Standard ISO 286 "Systems of Limits and Fits," and to the German Standards DIN 7150, 7151, 7160, and 7161.

The ISO-system of limits and fits refers to the space contained by two parallel faces of any part, such as Diameters, Lengths, Widths and Thicknesses of internal or external dimensions.

FIG. 1

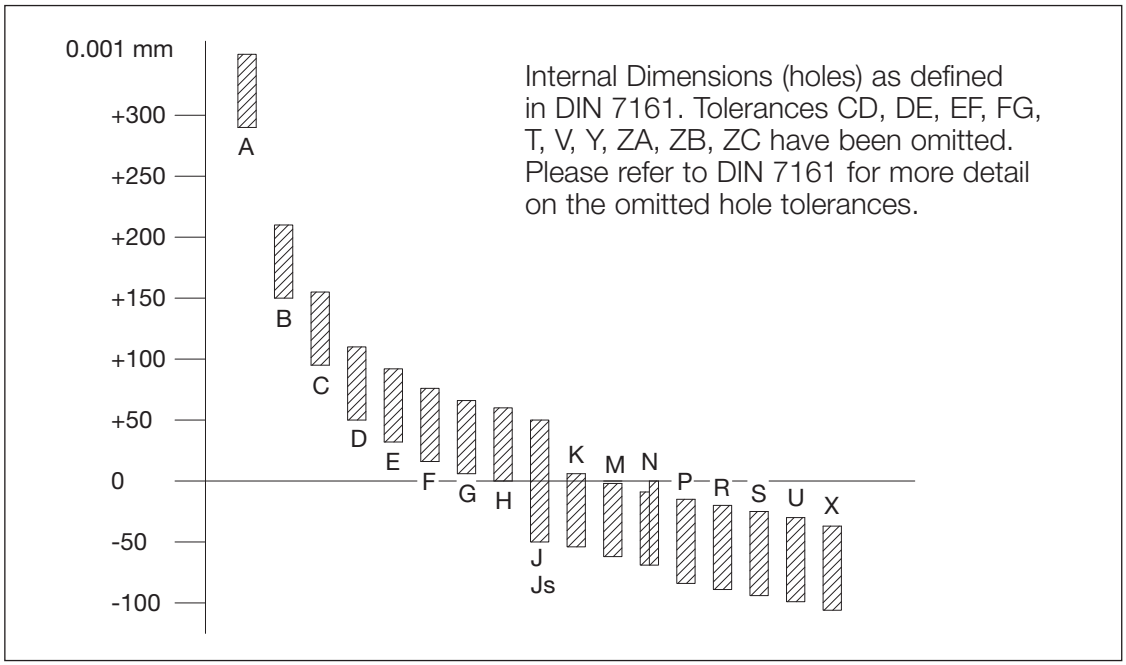
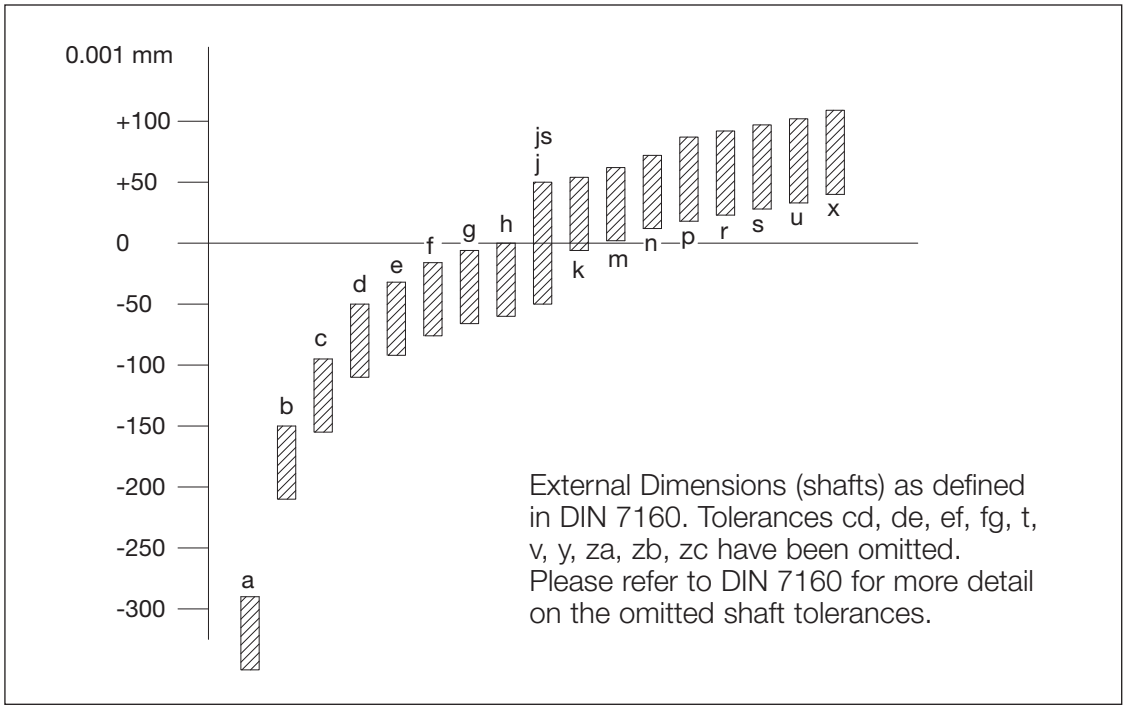


FIG. 2



Specifications for Tolerances and Fits, continued

A generic ISO assembly tolerance contains several distinct parts, each with a specific meaning. For example, a close running clearance fit with a shaft basis would be labeled as "F8/h7."

To achieve the requirements for tolerancing individual parts, a range of tolerances is required for each nominal size. Then, to define the fits between parts, a range of allowances that determine the position of these tolerances is also required.

ISO tolerances involve holding one face at a basic nominal value while the other face is placed at a specific distance to maintain the desired tolerance (clearance, transition or interference) that achieves the desired maximum and minimum limits of the assembled parts. Each tolerance zone position is defined by a letter. Small letters refer to external sizes (shafts) while capital letters refer to internal sizes (holes).

The tolerance grade (quality) is designated by an "IT" number that ranges from 01 up to 18. The tolerance grade will define the actual tolerance for an individual part at a specific nominal size. The position letter defined above will determine where the tolerance zone is relative to the zero line (see Figs. 1 and 2).

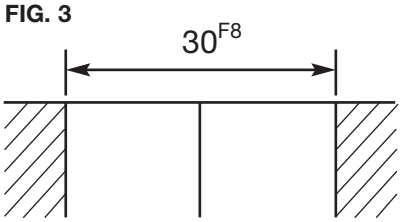
By combining the position letter with the IT grade number, the maximum and minimum limits of the assembled parts are defined. This combined tolerance symbol can be expressed as either a shaft-basis tolerance or as a hole-basis tolerance. Figs. 5 and 6 provide simplified representations of the hole-basis and shaft-basis assembly fits assuming that the basis component is held constant (i.e., the shaft in Fig. 4 shaft-basis assembly fit diagram). In reality, the tolerances for the shaft basis would be taken rom Fig. 2 (External dimensions – shafts), while the tolerances for the hole would be taken from Fig. 1 (Internal Dimensions – holes). The same would apply for a hole-basis assembly fit.

For example, the tolerance symbol for a close running clearance fit with a shaft basis was defined above as "F8/h7." If the nominal shaft diameter is 30 mm, the corresponding tolerances would be as follows:

Example:

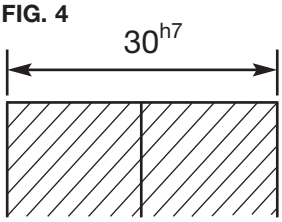
Nominal size: 30mm
Shaft Basis
Close Running Fit

FIG. 3



HOLE

FIG. 4



SHAFT

Tolerance symbol: F8/h7

	[mm]
Max. limit of size	30.053
Min. limit of size	30.020
Tolerance allowance	0.033

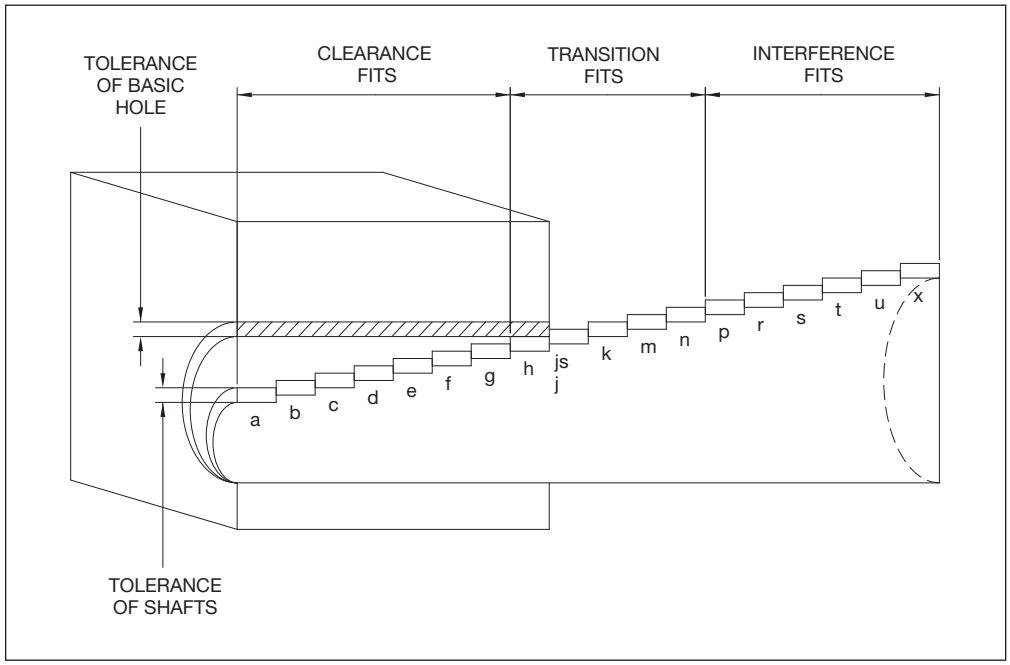
	[mm]
Max. limit of size	30.000
Min. limit of size	29.979
Tolerance allowance	0.021

Assembly allowance = Min hole – Max shaft
= 30.020 mm – 30.000 mm = 0.020 mm

Appendix G:
Specifications for Tolerances and Fits, and Hole and Shaft Basis Fit Tolerances

Shaft Basis Fit Tolerances

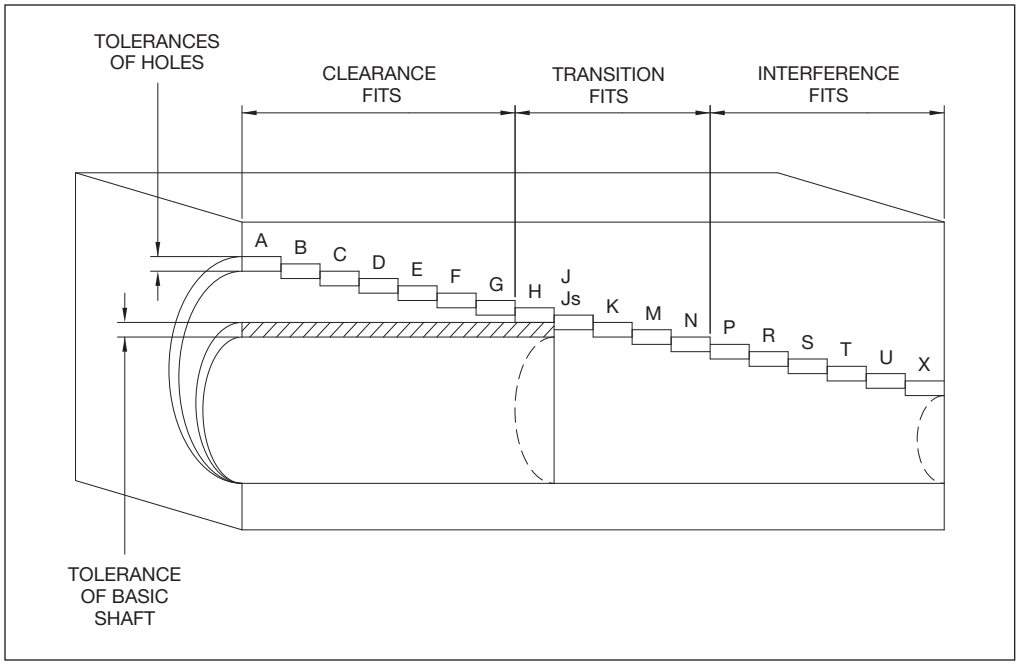
FIG. 5



Note: Not shown to scale. For visual aid and representation only. Please refer to provided tolerance charts for precise detail.

Hole Basis Fit Tolerances

FIG. 6



Note: Not shown to scale. For visual aid and representation only. Please refer to provided tolerance charts for precise detail.

Metric Components Index

Pins and Sleeves

Mold Components

Mold Components – continued

Appendices

World Headquarters
D-M-E Company
29111 Stephenson Highway
Madison Heights, MI 48071
800-626-6653 *toll-free tel*
248-398-6000 *tel*
888-808-4363 *toll-free fax*
www.dme.net *web*
appl_eng@dme.net *e-mail*

D-M-E of Canada, Ltd.
6210 Northwest Drive
Mississauga, Ontario
Canada L4V 1J6
800-387-6600 *toll-free tel*
905-677-6370 *tel*
800-461-9965 *toll-free fax*

D-M-E Europe
D-M-E Belgium C.V.B.A.
Industriepark Noord
B-2800 Mechelen, Belgium
32-15-215011 *tel*
32-15-218235 *fax*
www.dmeeu.com *web*
dme_europe@dmeeu.com *e-mail*

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