Conversion of Units[1]

Length

1 millimeter	= 0.0394 inch
1 centimeter	= 0.394 inch
1 meter	= 39.4 inches
1 meter	= 3.2808 feet
1 kilometer	= 0.62137 mile
1 inch	= 25.4 millimeters
1 inch	= 2.54 centimeters
1 foot	= 30.48 centimeters
1 foot	= 0.305 meter
1 yard	= 0.9144 meter
1 mile	= 1.60935 meters

Area

1 square millimeter	= 0.00155 square inch
1 square centimeter	= 0.1550 square inch
1 square meter	= 10.764 square feet
1 square kilometer	= 0.3861 square mile
1 square inch	= 6.452 square centimeters
1 square inch	= 645.2 square millimeters
1 square foot	= 0.0929 square meter
1 square yard	= 0.8361 square meter
1 square mile	= 2.590 square kilometers

Volume

1 cubic millimeter	= 0.0006 cubic inch
1 cubic centimeter	= 0.0610 cubic inch
1 liter	= 0.26418 US gallon
1 liter	= 1000 cubic centimeters
1 cubic meter	= 1.3079 cubic yards
1 cubic meter	= 35.313 cubic feet
1 cubic meter	= 264.143 US gallons
1 cubic inch	= 16.3872 cubic centimeters
1 cubic inch	= 1638.72 cubic millimeters
1 US gallon	= 3.78533 liters
1 cubic foot	= 28.32 liters
1 cubic foot	= 0.02832 cubic meters
1 cubic foot	= 1728 cubic inches
1 cubic foot	= 7.48 US gallons
1 cubic yard	= 0.7656 cubic meter

[1] Source: North American Combustion Handbook, Volume II, North American Mfg. Co., Cleveland OH 44105 USA, p. 317 - 325.

Conversion of Units (continued)

Weight

1 gram	= 15.4324 grains
1 kilogram	= 2.20462 pounds
1 Tonne (metric)	= 1000 kilograms
1 Tonne (metric)	= 2200 pounds
1 Tonne (metric)	= 1.1023 US Tons
1 grain	= 0.0648 ounce
1 ounce	= 28.3495 grams
1 pound	= 0.45359 kilogram
1 pound	= 16 ounces
1 Ton (US)	= 2000 pounds
1 Ton (US)	= 907.18 kilograms

Pressure

1 kg/cm^2	= 14.22 psi (lb/in^2)
1 bar	= 750.1 mm Mercury
1 bar	= 100.0 kPa (kilopascal)
1 bar	= 10,200 mm WC
1 bar	= 14.50 psi (lb/in^2)
1 psi (lb/in^2)	= 0.0703 kg/cm^2
1 psi (lb/in^2)	= 0.06897 bar

Power, Work, and Heat

1 Calorie	= 0.00397 Btu
1 Kilocalorie	= 3.968 Btu
1 KCalorie/Kg	= 1.8037 Btu/lb
1 Watt	= 0.056884 BTU/min.
1 watt	= 1 X 10^7 ergs/sec.
1 Kilowatt	= 738 ft-lbs/sec.
1 Kilowatt	= 1.341 horsepower
1 BTU	= 252.0 Calories
1 BTU	= 0.2520 Kilocalories
1 BTU/pound	= 0.5556 KCal/kilogram
1 horsepower	= 745.7 watts
1 horsepower	= 33,000 ft-lbs/min.

Temperature Conversion

Formulas for conversion:

°F = (°C x 1.8) + 32 °C = (°F - 32)/1.8

To use the table below, locate the temperature to be converted in the center column. Then to convert °F to °C read the left column; to convert °C to °F read the right column.

°C		°F
-23	-10	**24**
-17.7	0	**32**
-17.2	1	**33.8**
-16.6	2	**35.6**
-16.1	3	**37.4**
-15.5	4	**39.2**
-15.0	5	**41**
-14.4	6	**42.8**
-13.9	7	**44.6**
-13.3	8	**46.4**
-12.7	9	**48.2**
-12.2	10	**50**
-6.6	20	**68**
-1.1	30	**86**
4.4	40	**104**
9.9	50	**122**
15.6	60	**140**
21.0	70	**158**
26.8	80	**176**
32.1	90	**194**
37.7	100	**212**
43	110	**230**
49	120	**248**
54	130	**266**
60	140	**284**
65	150	**302**
71	160	**320**
76	170	**338**
83	180	**356**
88	190	**374**
93	200	**392**
99	210	**410**
104	220	**428**
110	230	**446**
115	240	**464**
121	250	**482**

°C		°F
127	260	**500**
132	270	**518**
138	280	**536**
143	290	**554**
149	300	**572**
154	310	**590**
160	320	**608**
165	330	**626**
171	340	**644**
177	350	**662**
182	360	**680**
188	370	**698**
193	380	**716**
199	390	**734**
204	400	**752**
210	410	**770**
215	420	**788**
221	430	**806**
226	440	**824**
232	450	**842**
238	460	**860**
243	470	**878**
249	480	**896**
254	490	**914**
260	500	**932**
265	510	**950**
271	520	**968**
276	530	**986**
280	540	**1004**
288	550	**1022**
293	560	**1040**
299	570	**1058**
304	580	**1076**
310	590	**1084**
315	600	**1112**

°C		°F
321	610	**1130**
326	620	**1148**
332	630	**1166**
338	640	**1184**
343	650	**1202**
349	660	**1220**
354	670	**1238**
360	680	**1256**
365	690	**1274**
371	700	**1292**
376	710	**1310**
382	720	**1328**
387	730	**1346**
393	740	**1364**
399	750	**1382**
404	760	**1400**
410	770	**1418**
415	780	**1436**
421	790	**1454**
426	800	**1472**
432	810	**1490**
438	820	**1508**
443	830	**1526**
449	840	**1544**
454	850	**1562**
460	860	**1580**
465	870	**1598**
471	880	**1616**
476	890	**1634**
482	900	**1652**
487	910	**1670**
493	920	**1688**
498	930	**1706**
504	940	**1724**
510	950	**1742**

°C		°F
515	960	**1760**
520	970	**1778**
526	980	**1796**
532	990	**1814**
538	1000	**1832**
543	1010	**1850**
549	1020	**1868**
554	1030	**1886**
560	1040	**1904**
565	1050	**1922**
571	1060	**1940**
576	1070	**1958**
582	1080	**1976**
587	1090	**1994**
593	1100	**2012**
598	1110	**2030**
604	1120	**2048**
609	1130	**2066**
615	1140	**2084**
620	1150	**2102**
626	1160	**2120**
631	1170	**2138**
637	1180	**2156**
642	1190	**2174**
648	1200	**2192**
654	1210	**2210**
660	1220	**2228**
666	1230	**2246**
671	1240	**2264**
677	1250	**2282**
682	1260	**2300**
688	1270	**2318**
693	1280	**2336**
699	1290	**2354**
704	1300	**2372**

Stretcher Capacity Calculation – English Units

For Aluminum Alloys - 6061 - 6063

Alloy 6063 T4 (yield = 10000psi)			Alloy 6061 T4 (yield = 16000psi)			Alloy 6061 T6 (yield = 35000psi)		
Stretcher Capacity US Tons	Area of Profile In^2	Weight Lb/foot	**Stretcher Capacity US Tons**	Area of Profile In^2	Weight Lb/foot	**Stretcher Capacity US Tons**	Area of Profile In^2	Weight Lb/foot
2	0.40	0.48	2	0.25	0.30	2	0.11	0.14
4	0.80	0.96	4	0.50	0.60	4	0.23	0.27
6	1.20	1.44	6	0.75	0.90	6	0.34	0.41
8	1.60	1.92	8	1.00	1.20	8	0.46	0.55
10	2.00	2.40	10	1.25	1.50	10	0.57	0.69
15	3.00	3.60	15	1.88	2.25	15	0.86	1.03
20	4.00	4.80	20	2.50	3.00	20	1.14	1.37
25	5.00	6.00	25	3.13	3.75	25	1.43	1.71
30	6.00	7.20	30	3.75	4.50	30	1.71	2.06
35	7.00	8.40	35	4.38	5.25	35	2.00	2.40
40	8.00	9.60	40	5.00	6.00	40	2.29	2.74
45	9.00	10.80	45	5.63	6.75	45	2.57	3.09
50	10.00	12.00	50	6.25	7.50	50	2.86	3.43
55	11.00	13.20	55	6.88	8.25	55	3.14	3.77
60	12.00	14.40	60	7.50	9.00	60	3.43	4.11
65	13.00	15.60	65	8.13	9.75	65	3.71	4.46
70	14.00	16.80	70	8.75	10.50	70	4.00	4.80
75	15.00	18.00	75	9.38	11.25	75	4.29	5.14
80	16.00	19.20	80	10.00	12.00	80	4.57	5.49
85	17.00	20.40	85	10.63	12.75	85	4.86	5.83
90	18.00	21.60	90	11.25	13.50	90	5.14	6.17
95	19.00	22.80	95	11.88	14.25	95	5.43	6.51
100	20.00	24.00	100	12.50	15.00	100	5.71	6.86
110	22.00	26.40	110	13.75	16.50	110	6.29	7.54
125	25.00	30.00	125	15.63	18.75	125	7.14	8.57
150	30.00	36.00	150	18.75	22.50	150	8.57	10.29
175	35.00	42.00	175	21.88	26.25	175	10.00	12.00
200	40.00	48.00	200	25.00	30.00	200	11.43	13.71
225	45.00	54.00	225	28.13	33.75	225	12.86	15.43
250	50.00	60.00	250	31.25	37.50	250	14.29	17.14
275	55.00	66.00	275	34.38	41.25	275	15.71	18.86
300	60.00	72.00	300	37.50	45.00	300	17.14	20.57
350	70.00	84.00	350	43.75	52.50	350	20.00	34.00
400	80.00	96.00	400	50.00	60.00	400	22.86	27.43
450	90.00	108.00	450	56.25	67.50	450	25.71	30.86
500	100.00	120.00	500	62.50	75.00	500	28.57	34.29
550	110.00	132.00	550	68.75	82.50	550	31.43	37.71
600	120.00	144.00	600	75.00	90.00	600	34.29	41.14
650	130.00	156.00	650	81.25	97.50	650	37.14	44.57
700	140.00	168.00	700	87.50	105.00	700	40.00	48.00
750	150.00	180.00	750	93.75	112.50	750	42.86	51.43
800	160.00	192.00	800	100.00	120.00	800	45.71	54.86
900	180.00	216.00	900	112.50	135.00	900	51.43	61.71
1000	200.00	240.00	1000	125.00	150.00	1000	57.14	68.57

Stretcher Capacity Calculation – Metric Units

For Aluminum Alloys - 6061 - 6063

Alloy 6063 T4 (yield =68.95MPa)			Alloy 6061 T4 (yield =110.32MPa			Alloy 6061 T6 (yield =241.33MPa)		
Stretcher Capacity M Tons	Area of Profile mm^2	Weight kg/M	**Stretcher Capacity M Tons**	Area of Profile mm^2	Weight kg/M	**Stretcher Capacity M Tons**	Area of Profile mm^2	Weight kg/M
2	290	0.80	2	181	0.50	2	83	0.23
4	580	1.60	4	363	1.00	4	166	0.46
6	870	2.39	6	544	1.50	6	249	0.68
8	1160	3.19	8	725	1.99	8	332	0.91
10	1450	3.99	10	906	2.49	10	414	1.14
15	2175	5.98	15	1360	3.74	15	622	1.71
20	2901	7.98	20	1813	4.99	20	829	2.28
25	3626	9.97	25	2266	6.23	25	1036	2.85
30	4351	11.97	30	2719	7.48	30	1243	3.42
35	5076	13.96	35	3173	8.72	35	1450	3.99
40	5801	15.95	40	3626	9.97	40	1658	4.56
45	6526	17.95	45	4079	11.22	45	1865	5.13
50	7252	19.94	50	4532	12.46	50	2072	5.70
60	8702	23.93	60	5439	14.96	60	2486	6.84
70	10152	27.92	70	6345	17.45	70	2901	7.98
75	10877	29.91	75	6798	18.70	75	3108	8.55
80	11603	31.91	80	7252	19.94	80	3315	9.12
85	12328	33.90	85	7705	21.19	85	3522	9.69
90	13053	35.90	90	8158	22.43	90	3729	10.26
95	13778	37.89	95	8611	23.68	95	3937	10.83
100	14503	39.88	100	9065	24.93	100	4144	11.40
110	15954	43.87	110	9971	27.42	110	4558	12.53
120	17404	47.86	120	10877	29.91	120	4973	13.67
125	18129	49.85	125	11331	31.16	125	5180	14.24
150	21755	59.83	150	13597	37.39	150	6216	17.09
175	25381	69.80	175	15863	43.62	175	7252	19.94
200	29007	79.77	200	18129	49.85	200	8288	22.79
225	32632	89.74	225	20395	56.09	225	9324	25.64
250	36258	99.71	250	22661	62.32	250	10359	28.49
275	39884	109.68	275	24927	68.55	275	11395	31.34
300	43510	119.65	300	27194	74.78	300	12431	34.19
325	47136	129.62	325	29460	81.01	325	13467	37.04
350	50761	139.59	350	31726	87.25	350	14503	39.88
400	58013	159.54	400	36258	99.71	400	16575	45.58
450	65265	179.48	450	40790	112.17	450	18647	51.28
500	72516	199.42	500	45323	124.64	500	20719	56.98
550	79768	219.36	550	49855	137.10	550	22791	62.67
600	87020	239.30	600	54387	149.56	600	24863	68.37
650	94271	259.25	650	58920	162.03	650	26935	74.07
700	101523	279.19	700	63452	174.49	700	29007	79.77
750	108774	299.13	750	67984	186.96	750	31078	85.47
800	116026	319.07	800	72516	199.42	800	33150	91.16
900	130529	358.96	900	81581	224.35	900	37294	102.56
1000	145033	398.84	1000	90645	249.27	1000	41438	113.95

Weight of Extrusion Billets

For Aluminum Alloys 1100 - 6061 - 6063 only

Billet Length (inches)	Weight (in Pounds) for Diameter (in inches)								
	5”	6”	7”	8”	9”	10”	11”	12”	14”
1”	1.893	2.714	3.700	4.878	6.129	7.621	9.221	10.83	14.937
8”	15.14	21.71	29.60	39.02					
9”	17.04	24.43	33.30	43.90	55.16				
10”	18.93	27.14	37.00	48.78	61.29	76.21			
11”	20.82	29.85	40.70	53.66	67.42	83.83	101.43		
12”	22.72	32.57	44.40	58.54	73.55	91.45	110.65	129.96	
13”	24.61	35.28	48.10	63.41	79.68	99.07	119.87	140.79	
14”	26.50	38.00	51.80	68.29	85.81	106.69	129.09	151.62	209.12
15”	28.40	40.71	55.50	73.17	91.94	114.32	138.32	162.45	224.06
16”	30.29	43.42	59.20	78.05	98.06	121.94	147.54	173.28	238.99
17”	32.18	46.14	62.90	82.93	104.19	129.56	156.76	184.11	253.93
18”	34.07	48.85	66.60	87.80	110.32	137.18	165.98	194.94	268.87
19”	35.97	51.57	70.30	92.68	116.45	144.80	175.20	205.77	283.80
20”	37.86	54.28	74.00	97.56	122.58	152.42	184.42	216.60	298.74
21”	39.75	56.99	77.70	102.44	128.71	160.04	193.64	227.43	313.68
22”	41.65	59.71	81.40	107.32	134.84	167.66	202.86	238.26	328.61
23”	43.54	62.42	85.10	112.19	140.97	175.28	212.08	249.09	343.55
24”	45.43	65.14	88.80	117.07	147.10	182.90	221.30	259.92	358.49
25”	47.33	67.85	92.50	121.95	153.23	190.53	230.53	270.75	373.43
26”	49.22	70.56	96.20	126.83	159.35	198.15	239.75	281.58	388.36
27”	51.11	73.28	99.90	131.71	165.48	205.77	248.97	292.41	403.30
28”	53.00	75.99	103.60	136.58	171.61	213.39	258.19	303.24	418.24
29”	54.90	78.71	107.30	141.46	177.74	221.01	267.41	314.07	433.17
30”	56.79	81.42	111.00	146.34	183.87	228.63	276.63	324.90	448.11
31”	58.68	84.13	114.70	151.22	190.00	236.25	285.85	335.73	463.05
32”	60.58	86.85	118.40	156.10	196.13	243.87	295.07	346.56	477.98
33”	62.47	89.56	122.10	160.97	202.26	251.49	304.29	357.39	492.92
34”	64.36	92.28	125.80	165.85	208.39	259.11	313.51	368.22	507.86
35”	66.26	94.99	129.50	170.73	214.52	266.74	322.74	379.05	522.80
36”		97.70	133.20	175.61	220.64	274.36	331.96	389.88	537.73
37”		100.42	136.90	180.49	226.77	281.98	341.18	400.71	552.67
38”		103.13	140.60	185.36	232.90	289.60	350.40	411.54	567.61
39”		105.85	144.30	190.24	239.03	297.22	359.62	422.37	582.54
40		108.56	148.00	195.12	245.16	304.84	368.84	433.20	597.48
41			151.70	200.00	251.29	312.46	378.06	444.03	612.42
42			155.40	204.88	257.42	320.08	387.28	454.86	627.35
43			159.10	209.75	263.55	327.70	396.50	465.69	642.29
44			162.80	214.63	269.68	335.32	405.72	476.52	657.23
45				219.51	275.81	342.95	414.95	487.35	672.17
46				224.39	281.93	350.57	424.17	498.18	687.10
47				229.27	288.06	358.19	433.39	509.01	702.04
48				234.14	294.19	365.81	442.61	519.84	716.98

Press Specific Pressure – English Units

To calculate Specific Pressure on the die face:

$$P_s = \text{Press tonnage} \div \text{container area}$$

$$P_s = \text{Press tonnage} \times 2000 / \pi\,(\text{container ID})^2 / 4$$

where P_s is in pounds/square inch and container ID is in inches (typically 3% larger than billet diameter.

Billet Dia.-in.	6”	7”	8”	9”	10”	12”	14”
Container I.D. – in.	6.18	7.21	8.24	9.27	10.3	12.36	14.42
Container Area - sqin	30.00	40.83	53.33	67.49	83.32	119.99	163.31
Press Tons ↓	Press Specific pressure on Die Face – pounds/square inch						
900	60,008						
1200	80,010	58,783					
1400	93.345	68,580					
1600	106,680	78,377	60,008				
1800	120,015	88,174	67,508				
2000	133,350	97,971	75,009	59,267			
2200		107,769	82,510	65,193			
2400		117,566	90,011	71,120	57,607		
2500		122,464	93,762	74,083	60,008		
2750			103,138	81,492	66,008		
3000			112,514	88,900	72,009		
3250			121,890	96,308	78,010	54,173	
3500				103,717	84,011	58,341	
3750				111,125	90,011	62,508	
4000					96,012	66,675	
4250					102,013	70,842	52,047
4500					108,014	75,009	55,109
5000						83,344	61,232
5500						91,678	67,355
6000						100,013	73,479
6500							79,602
7000							85,725

Notes:

1. Many experts recommend operating with Specific Pressure (die face pressure) in the range of 85,000 to 115, 000 pounds/square inch.
2. Many North American extruders operate in the range 70,000 to 80,000 psi.
3. For extruding with longer billets (length greater than 4x billet diameter), Specific Pressures must be higher in the range of 120,000 psi, due to increased container friction[2].
4. The optimum range of Specific Pressure will also depend on extrusion practices and the type of profile or bar being extruded.

[2] Robbins, Paul; Dixon, Bill; Chien, Ken; and Jowett, Chris; “Today’s Understanding of the Function and Benefits of DummyBlock Design,” *Proceedings of 11th International Aluminum Extrusion Technology Seminar,* (2016), p.387-404.

Press Specific Pressure – Metric Units

To calculate Specific Pressure on the die face:

$$P_s = \text{Press tonnage} \div \text{container area}$$

$$P_s = \text{Press tonnage} \times 1000 / \pi\,(\text{container ID})^2 / 4$$

where P_s is in kilograms/square millimeter and container ID is in millimeters (typically 3% larger than billet diameter.

Billet Dia. – in.	6”	7”	8”	9”	10”	12”	14”
Billet Dia,-mm	152	178	203	228	254	305	356
Container ID-mm	160	185	210	236	262	314	365
Container Area – mm2	20106	26880	34636	43744	53913	77437	104635
Press MTons ↓	Press Specific pressure on Die Face – kilograms/square millimeter						
800	39.79						
1000	49.74	37.20					
1200	59.68	44.64					
1400	69.63	52.08	40.42				
1600	79.58	59.52	46.19	36.58			
1800	89.52	66.96	51.97	41.15			
2000	99.47	74.40	57.74	45.72	37.10		
2200		81.84	63.52	50.29	40.81		
2400		89.28	69.29	54.87	44.52		
2600		96.73	75.07	59.44	48.23		
2800			80.84	64.01	51.94		
3000			86.61	68.58	55.65	38.74	
3200			92.39	73.15	59.36	41.32	
3400			98.16	77.73	63.06	43.91	
3600				82.30	66.77	46.49	
3800				86.87	70.48	49.07	
4000				91.44	74.19	51.65	38.23
4500					83.47	58.11	43.01
5000					92.74	64.57	47.79
5500						71.03	52.56
6000						77.48	57.34
7000						90.40	66.9

Notes:

1. Many experts recommend operating with Specific Pressure (die face pressure) in the range of 60 to 80 kilograms/square millimeter.
2. Many North American extruders operate in the range 50 to 60 kg/mm2.
3. For extruding with longer billets (length greater than 4x billet diameter), Specific Pressures must be somewhat higher in the range of 825MPa, due to increased container friction[3].
4. The optimum range of Specific Pressure will also depend on extrusion practices and the type of profile or bar being extruded.

[3] ibid

Millimeter Conversion

mm	Inches	mm	Inches	mm	inches
0.1	.0039	41	1.6142	90	3.5433
0.2	.0079	42	1.6535	91	3.5827
0.3	.0118	43	1.6929	92	3.6220
0.4	.0157	44	1.7323	93	3.6614
0.5	.0197	45	1.7717	94	3.7008
0.6	.0236	46	1.8110	95	3.7402
0.7	.0276	47	1.8504	96	3.7795
0.8	.0315	48	1.8898	97	3.8189
0.9	.0354	49	1.9291	98	3.8583
1	.0393	50	1.9685	99	3.8976
2	.0787	51	2.0079	100	3.9370
3	0.1181	52	2.0472		
4	0.1575	53	2.0866	25.4	1
5	0.1969	54	2.1260	50.8	2
6	0.2362	55	2.1654	76.2	3
7	0.2756	56	2.2047	101.6	4
8	0.3150	57	2.2441	127.0	5
9	0.3543	58	2.2835	152.4	6
10	0.3937	59	2.3228	177.8	7
11	0.4331	60	2.3622	203.2	8
12	0.4724	61	2.4016	228.6	9
13	0.5118	62	2.4409	254.0	10
14	0.5512	63	2.4803	279.4	11
15	0.5906	64	2.5197	304.8	12
16	0.6299	65	2.5591	330.2	13
17	0.6693	66	2.5984	355.6	14
18	0.7087	67	2.6378	381.0	15
19	0.7480	68	2.6772	406.4	16
20	0.7874	69	2.7165	431.8	17
21	0.8268	70	2.7559	457.2	18
22	0.8661	71	2.7953	482.6	19
23	0.9055	72	2.8346	508.0	20
24	0.9449	73	2.8740	609.6	24
25	0.9843	74	2.9134	762.0	30
26	1.0236	75	2.9528	914.4	36
27	1.0630	76	2.9921	1066.8	42
28	1.1024	77	3.0315	1219.2	48
29	1.1417	78	3.0709	1371.6	54
30	1.1811	79	3.1102	1524.0	60
31	1.2205	80	3.1496	1828.8	72
32	1.2598	81	3.1890	2133.6	84
33	1.2992	82	3.2283	2438.4	96
34	1.3386	83	3.2677	2743.2	108
35	1.3780	84	3.3071	3048.0	120
36	1.4173	85	3.3465		
37	1.4567	86	3.3858		
38	1.4961	87	3.4252		
39	1.5354	88	3.4646		
40	1.5748	89	3.5039		

Recommended Time Limit for Tooling in Oven After Reaching Temperature

500°F .....Unlimited
600°F ..... 30 hours
700°F ..... 10 hours
800°F ..... 6 hours
900°F ..... 2 hours

Thermocouple Types Used in Extrusion Plants

Type J:

Iron-Constantan	**I/C**	**one wire silver and one wire bronze in color**	
Iron:	**Magnetic**	**Positive**	**White**
Constantan:	**Non-magnetic**	**Negative**	**Red**

Type K:

Chromel/Alumel	**C/A**	**both wires silver in color**	
Chromel:	**Non-magnetic**	**Positive**	**Yellow**
Alumel:	**Magnetic**	**Negative**	**Red**

Note: Thermocouple lead wire must be located in a dry, grounded, steel conduit and separated from power wiring. Do not use wire-pulling lubricant.

Glossary of Terms for Press Components

Press Base or Bedplate: a welded structure, it is designed to accurately position and support the press structure. It is precisely leveled, anchored, and grouted to the concrete press foundation.

Main Cylinder: the hydraulic cylinder, normally cast or forged steel, incorporates the *Main Cylinder Flange*, also sometimes called the *Main Cylinder Platen*; other Main Cylinder parts include the *Main Cylinder Bearing Bushing* and *Main Cylinder Packing* system.

Main Ram: the piston of the main hydraulic cylinder.

Crosshead (or ***Moving Crosshead***): mounted on the *Main Ram*, the *Crosshead* is fitted with the *Extrusion Stem*, and with guide shoes to guide the main ram travel along the *Guide Ways*.

Crosshead Cylinders or ***Pullback Cylinders***: for rapid pull-back of the main ram at speeds not possible using main cylinder action alone; mounted on the *Main Cylinder* housing or *Platen*.

Extrusion Stem or ***Ram Stem***: pushes the billet through the *Container*. Various mounting designs are used to permit precise adjustment and alignment of the stem. To avoid sticking or "welding" to the billet, a *Dummy Block* is fixed to the nose of the stem. Older presses used *Loose Dummy Blocks*, mechanically fed into position with each bullet, then removed, separated, and recycled. Today almost all presses incorporate *Fixed Dummy Blocks* mounted on the *Stem*.

Guide Ways: for guiding the *Moveable Crosshead* and *Container*, although many presses use separate guide systems for each. *Guide ways* are usually mounted on the *Press Frame* or *Bedplate*, or on the *Columns* or *Tie-Rods*.

Tie Rods or ***Columns***: operating in tension, these restrain the extrusion force between *the Main Cylinder Platen* and *Front* or *Resistance Platen*. The most common designs are: threaded tension rods with 4 nuts per rod (2 at each platen); threaded rods with fixed sleeves between platens; and laminated plates or bars.

Platen (also ***Front Platen*** or ***Resistance Platen***): cast or forged steel, it provides support for extrusion tooling and so is designed for minimum deflection under load. It incorporates also the *Pressure Ring*, a replaceable precision segment designed for extremely precise support of the *Tooling Stack*.

Tooling Stack or ***Die Stack***: includes the *die*, *die backer*, *bolster*, *die ring*, and other spacers as may be required to adapt a particular die to the standardized overall *Tooling Stack* dimensions for the particular press.

Die Changer: a device for rapid changing of dies. Common designs include:

- *single die changer*: the simplest system, it holds only one tooling stack at a time.
- *double die slide*: holds two tooling stacks, allowing advance set-up of the next set during extrusion and therefore faster die changes; but one pocket must be loaded from the far side of the press, away from the press operator's position.
- *unistation die changer*: also allows advance set-up and quick changes, fully accessible from the operator side of the press; dies are exchanged in a "shuttle" motion.
- *rotostation die changer*: similar to unistation, except a turntable rotates for exchanging die carriers.
- *gate lock*: on very old presses, dies are removed and reinserted through the front platen, then locked in place with a "gate lock" device, which also absorbs the resistance forces.

Container: retains the extrusion pressure against the die by containing the billet; incorporates a replaceable *Container Liner* to accommodate wearing tendencies.

Container Holder: supports, guides, and transports the *Container*; connected to the *Container Cylinders* and mounted on *Guide Shoes* which slide on the *Guide Ways*. Also incorporates *Container Heating Elements*, and their flexible electrical connections; and locking devices to retain the container firmly and precisely in position.

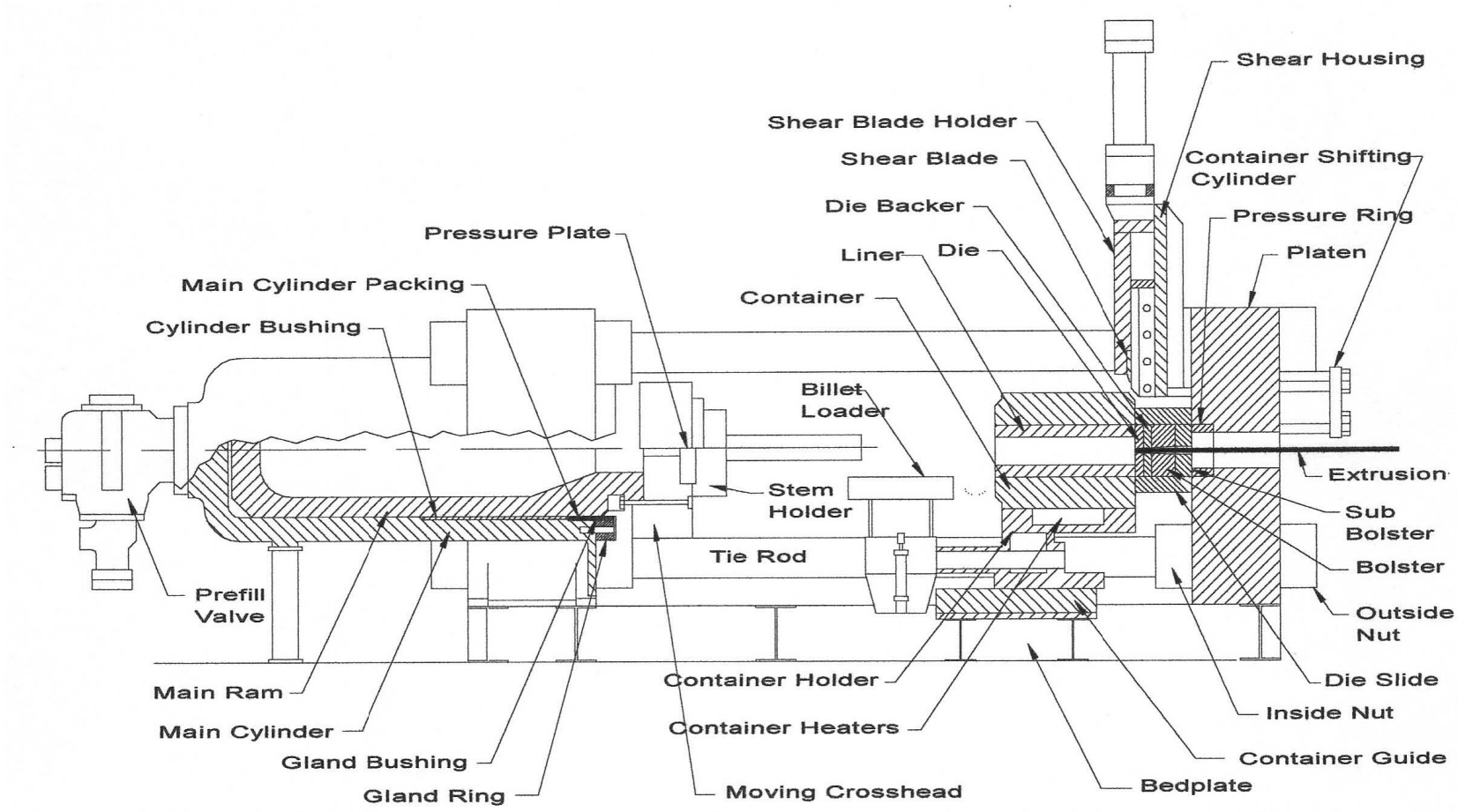
Container Cylinders: move the container away from the *Tooling Stack* during butt shearing (also during "burp cycle" and die changing); and provide sealing pressure to retain the container firmly against the *Tooling Stack* during extrusion.

Billet Loader: most commonly a swing-arm device mounted to the press frame. However, on newer presses this loader may be a robot device or an overhead carrier for increased reliability and positioning accuracy.

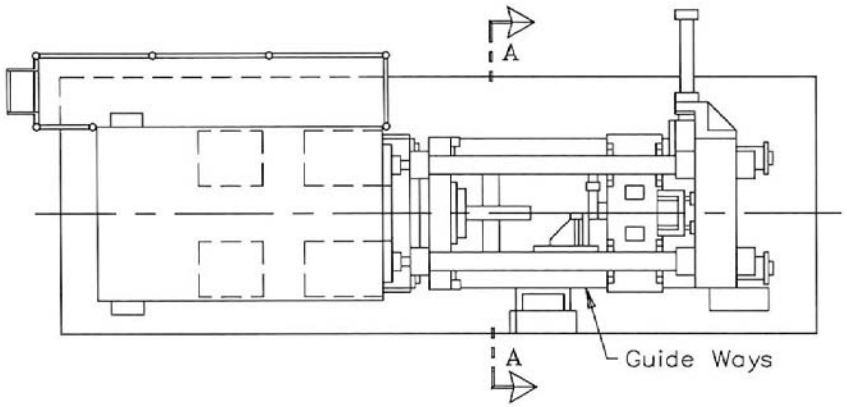
Butt Shear: for removal of the remaining billet or "butt" at the end of the extrusion cycle, a hydraulically powered blade descends to shear away the remainder. To insure complete removal, a *"Butt Knocker,"* usually pneumatically actuated, may also be provided to sweep the blade area.

Diagrams of Press Components

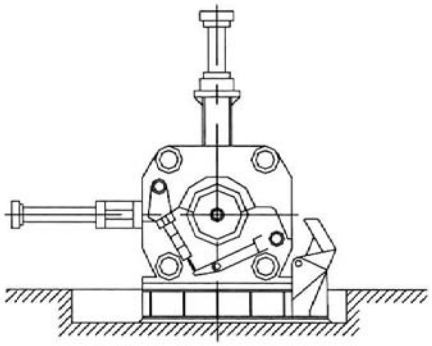
In order to provide a common reference of terminology, please see the extrusion press diagrams shown on the following pages. Terms used throughout this manual are defined according to this diagram and the *Glossary of Terms for Press Components* above.



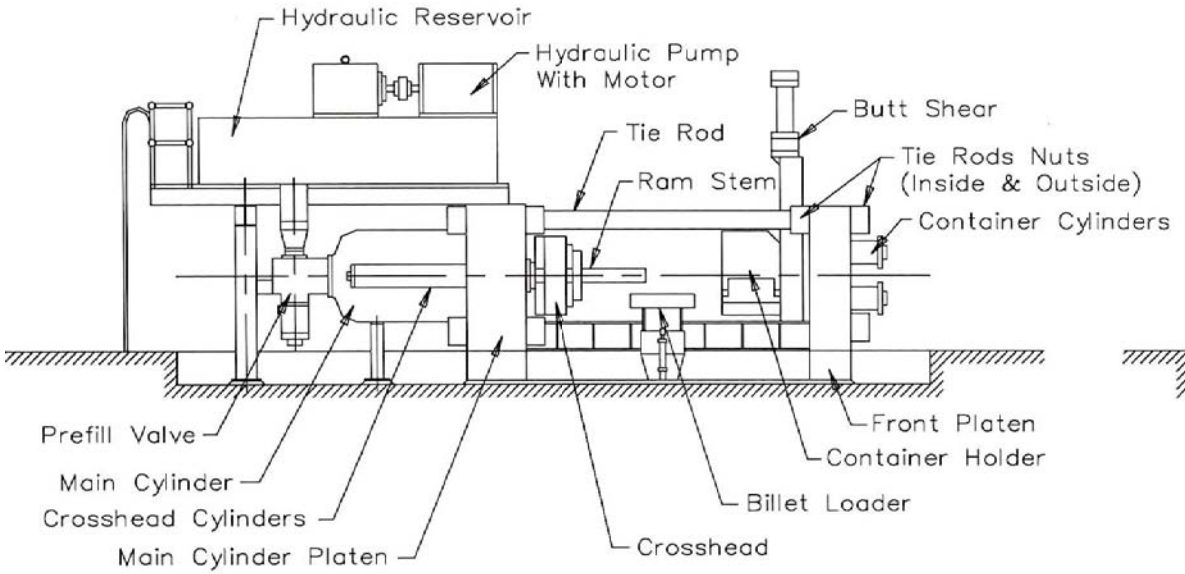
Identification of Press Components

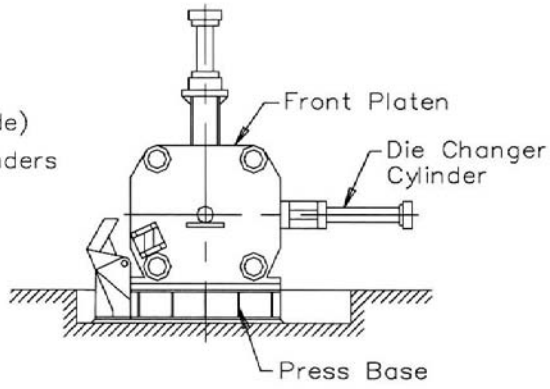


PLAN VIEW



SECTION A–A





END VIEW