Welding and Brazing Guide

Welding

BASE MATERIAL	WELDING FLAME	AVERAGE MELTING TEMPERATURE		FILLER METALS
				Hercules iron, BLUESHIELD LA Superweld
Mild steel	Neutral	**1450°C**	2600°F	or BLUESHIELD LA Hi-Tensile
Stainless steel	Neutral	**1250°C**	2300°F	Matching base material rods
Cast iron	Neutral to slightly oxidizing	**1200°C**	2200°F	Cast iron
Copper	Neutral	**1085°C**	1980°F	Copper rods
Brass	Neutral	**900°C**	1650°F	Altem Super Bronze
Silicon bronze	Neutral	**880°C**	1620°F	Everdur 656
Aluminum	Neutral	**660°C**	1220°F	1100, CRYSTAL 4043, 5356
Lead	Neutral	**325°C**	620°F	Base metal strips or rods
Chrome moly alloys	Neutral	Varies with Cr %		Chrome-Moly 1 1/4 Cr - 1/2 Mo
				2 1/4 Cr - 1 Mo

Brazing

BASE MATERIAL	FLUX	AVERAGE BRAZING TEMPERATURE		BRAZING ALLOYS
Carbon steel	Handy - flux	**650°C**	1200°F	Easy-Flo, Easy-Flo 3
Stainless steel	Handy - flux type B-1	**650°C**	1200°F	Easy-Flo 30, Easy-Flo 35
Copper alloys	Handy - flux	**650°C**	1200°F	or Easy-Flo 45
Carbon steel	None	**650°C**	1200°F	Sil-Fos or Sil-Fos 5
Copper alloys	None	**650°C**	1200°F	

Note: Use a neutral oxy-acetylene flame for brazing operations.
Easy-Flo and Sil-Fos are trademarks of Handy and Harman Cy.

Eye Protection

Filter Shade Selector for Welding or Cutting Goggles

WELDING OR CUTTING OPERATION		METAL THICKNESS			FILTER SHADE NUMBER
			mm	in.	
Torch soldering			**-**	-	2
Torch brazing			**-**	-	3 or 4
Oxygen cutting:	Light	Less than	**25**	1	3 or 4
	Medium		**25-150**	1- 6	4 or 5
	Heavy	Greater than	**150**	6	5 or 6
Gas welding:	Light	Less than	**3.2**	1/8	4 or 5
	Medium		**3.2-12.7**	1/8 -1/2	5 or 6
	Heavy	Greater than	**12.7**	1/2	6 or 8

Pressure Drop Data

Oxygen Hose

DELIVERY PRESSURE		OXYGEN FLOW		PRESSURE DROP kPa lb. per sq. in. (psi)																			
				5 mm 3/16 in. HOSE LENGTH						**6 mm** 1/4 in. HOSE LENGTH						**8 mm** 5/16 in. HOSE LENGTH						**9.5 mm** 3/8 in. HOSE LENGTH					
kPa	psi	L/min	cfh	7.6 m	25 ft.	15 m	50 ft.	30 m	100 ft.	7.6 m	25 ft.	15 m	50 ft.	30 m	100 ft.	7.6 m	25 ft.	15 m	50 ft.	30 m	100 ft.	7.6 m	25 ft.	15 m	50 ft.	30 m	100 ft.
69	10	**47**	100	**43**	6.3					**14**	2.0	**26**	3.8	**41**	6.0	•		•		**16**	2.3	•		•		**14**	2.0
		118	250													**28**	4.1	**41**	5.9			•		**23**	3.3	**44**	6.4
172	25	**47**	100	**39**	5.7	**57**	8.2	**92**	13.4	•		**20**	2.9	**30**	4.3	•		•		•		•		•		•	
		118	250	**124**	18.3					**55**	7.9	**81**	11.7	**116**	16.8	**17**	2.4	**22**	3.2	**46**	6.7	•		•		**26**	3.7
		235	500													**60**	8.7	**84**	12.1	**137**	19.9	**32**	4.6	**48**	6.9	**82**	11.9
345	50	**47**	100	**23**	3.4	**41**	5.9	**64**	9.3	•		**14**	2.0	**19**	2.7	•		•		•		•		•		•	
		118	250	**87**	12.6	**134**	19.4	**203**	29.4	**35**	5.0	**55**	7.9	**76**	11.0	•		**15**	2.2	**27**	3.9	•		•		**18**	2.6
		235	500	**237**	34.4					**126**	18.2	**178**	25.8	**242**	35.0	**41**	5.9	**53**	7.7	**92**	13.3	**20**	2.9	**32**	4.7	**55**	8.0
		352	750							**195**	28.3	**279**	40.5	**380**	55.0	**61**	8.8	**95**	13.7	**130**	18.8	**28**	4.1	**48**	7.0	**84**	12.2
		470	1000							**326**	47.3	**456**	66.1			**101**	14.7	**156**	22.6	**214**	31.0	**48**	6.9	**83**	12.0	**140**	20.3
517	75	**47**	100	**18**	2.6	**26**	3.8	**49**	7.1	•		•		**15**	2.2	•		•		•		•		•		•	
		118	250	**65**	9.4	**92**	13.3	**194**	28.1	**26**	3.8	**41**	6.0	**57**	8.2	•		•		**19**	2.8	•		•		**14**	2.0
		235	500	**192**	27.8	**293**	42.4	**452**	65.5	**95**	13.8	**137**	19.8	**188**	27.2	**27**	3.9	**44**	6.3	**65**	9.4	**14**	2.0	**24**	3.4	**41**	5.9
		352	750	**360**	52.2	**508**	73.6			**195**	28.3	**279**	40.5	**380**	55.0	**61**	8.8	**95**	13.7	**130**	18.8	**28**	4.1	**48**	7.0	**84**	12.2
		470	1000							**326**	47.3	**456**	66.1			**101**	14.7	**156**	22.6	**214**	31.0	**48**	6.9	**83**	12.0	**140**	20.3
690	100	**47**	100	•		**19**	2.7	**32**	4.6	•		•		•		•		•		•		•		•		•	

Note: To obtain the recommended inlet pressure to the apparatus, add the pressure drops (shown above) to the delivery pressure of the regulator.
*"•" indicates a pressure drop of less than **13.8 kPa** (2.0 lb. per sq. in.)*

Acetylene Hose

DELIVERY PRESSURE		ACETYLENE FLOW		PRESSURE DROP kPa lb. per sq. in. (psi)																			
				5 mm 3/16 in. HOSE LENGTH						**6 mm** 1/4 in. HOSE LENGTH						**8 mm** 5/16 in. HOSE LENGTH						**9.5 mm** 3/8 in. HOSE LENGTH					
kPa	psi	L/min	cfh	7.6 m	25 ft.	15 m	50 ft.	30 m	100 ft.	7.6 m	25 ft.	15 m	50 ft.	30 m	100 ft.	7.6 m	25 ft.	15 m	50 ft.	30 m	100 ft.	7.6 m	25 ft.	15 m	50 ft.	30 m	100 ft.
34	5	**11.75**	25	**3.5**	0.5	**6.9**	1.0	**21.4**	1.8	•	•	**3.5**	0.5	**5.5**	0.8	•	•	•	•	**2.1**	0.3	•	•	•	•	•	•
		23.5	50	**13.8**	2.0	**22.0**	3.2			**6.2**	0.9	**9.0**	1.3	**16.6**	2.4	**2.1**	0.3	**2.8**	0.4	**4.8**	0.7	•	•	**2.1**	0.3	**2.8**	0.4
		35.25	75	**26.9**	3.9					**21.4**	1.8	**17.9**	2.6	**31.1**	4.5	**3.5**	0.5	**5.5**	0.8	**9.7**	1.4	**2.1**	0.3	**3.5**	0.5	**5.5**	0.8
		47	100							**19.3**	2.8	**30.1**	4.4			**5.5**	0.8	**9.0**	1.3	**16.6**	2.4	**2.8**	0.4	**4.8**	0.7	**7.6**	1.1
		70.5	150													**11.7**	1.7	**18.6**	2.7	**33.1**	4.8	**5.5**	0.8	**8.3**	1.2	**15.2**	2.2
69	10	**11.75**	25	**3.5**	0.5	**5.5**	0.8	**9.7**	1.4	•	•	**2.1**	0.3	**4.8**	0.7	•	•	•	•	•	•	•	•	•	•	•	•
		23.50	50	**11.0**	1.6	**17.2**	2.5	**33.8**	4.9	**4.8**	0.7	**7.6**	1.1	**13.8**	2.0	•	•	**2.1**	0.3	**4.4**	0.6	•	•	•	•	**2.1**	0.3
		35.25	75	**21.4**	3.1	**43.5**	6.3			**9.7**	1.4	**15.2**	2.2	**25.5**	3.7	**2.8**	0.4	**3.5**	0.5	**4.4**	0.6	•	•	**2.1**	0.3	**4.4**	0.6
		47	100	**37.3**	5.4					**13.8**	2.0	**24.8**	3.6	**41.4**	6.0	**4.4**	0.6	**6.2**	0.9	**15.2**	2.2	**2.1**	0.3	**3.5**	0.5	**13.1**	1.9
		70.5	150							**31.1**	4.5	**50.4**	7.3			**9.0**	1.3	**14.5**	2.1	**26.9**	3.9	**4.4**	0.6	**6.9**	1.0	**17.3**	2.5
		117.5	250													**24.2**	3.5	**35.9**	5.2	**67.6**	9.8	**9.7**	1.4	**17.3**	2.5	**30.4**	4.4
		235	500																			**33.1**	4.8	**57.3**	8.3		
97	14	**11.75**	25	**2.8**	0.4	**4.8**	0.7	**9.0**	1.3	•	•	**2.1**	0.3	**4.4**	0.6	•	•	•	•	•	•	•	•	•	•	•	•
		23.5	50	**9.7**	1.4	**16.6**	2.4	**31.7**	4.6	**4.4**	0.6	**6.2**	0.9	**11.0**	1.6	•	•	•	•	**2.8**	0.4	•	•	•	•	**2.1**	0.3
		35.35	75	**20.0**	2.9	**27.6**	4.0	**69.0**	10.0	**8.3**	1.2	**13.1**	1.9	**20.7**	3.0	**2.1**	0.3	**3.5**	0.5	**6.9**	1.0	•	•	**2.1**	0.3	**3.5**	0.5
		47	100	**34.5**	5.1					**13.8**	2.0	**20.7**	3.0	**32.4**	4.7	**4.4**	0.6	**4.8**	0.7	**11.7**	1.7	**2.1**	0.3	**2.8**	0.4	**5.5**	0.8
		70.5	150							**27.6**	4.0	**41.4**	6.0	**60.3**	8.7	**8.3**	1.2	**11.7**	1.7	**23.5**	3.4	**3.5**	0.5	**6.2**	0.9	**11.0**	1.6
		117.5	250							**65.6**	9.5					**21.4**	3.1	**31.1**	4.5	**55.9**	8.1	**8.3**	1.2	**15.9**	2.3	**26.2**	3.8
		235	500													**72.5**	10.5	**94.5**	13.7			**27.6**	4.0	**55.9**	8.1	**79.4**	11.5

Note: To obtain the recommended inlet pressure to the apparatus, add the pressure drops (shown above) to the delivery pressure of the regulator.
*DO NOT exceed 103.5 kPa (15 psig) for acetylene. / "• •" indicates a pressure drop of less than **1.38 kPa** (0.2 lb per sq. in.)*

Pocket Guide for Oxy-fuel Gas

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Oxy-Fuel Cutting / Heating / Welding Operations Data

Acetylene Cutting Pressures[1] and Consumptions

APPROXIMATE TIP SIZES, CUTTING SPEEDS AND GAS PRESSURES FOR BLUESHIELD™ CUTTING TORCHES AND MEDIUM PRE-HEAT TIPS (STYLE 802)												
METAL THICKNESS		TIP SIZE	OXYGEN PRESSURE		OXYGEN CONSUMPTION		ACETYLENE PRESSURE		ACETYLENE CONSUMPTION		HAND CUTTING SPEED PER MINUTE	
mm	in.		kPa	psi	L/min	cfh	kPa	psi	L/min	cfh	mm	in.
3.2	1/8	00	207	30	14	30	27.6	4	4.2	9.0	431.8-482.6	17.0-19.0
6.0	1/4	0	207	30	21	45	27.6	4	5.6	12.0	406.4-457.2	16.0-18.0
9.5	3/8	1	207	30	35	75	27.6	4	6.3	13.5	368.3-419.1	14.5-16.5
13.0	1/2	1	276	40	40	85	27.6	4	6.3	13.5	304.8-368.3	12.0-14.5
19.0	3/4	2	276	40	56	120	27.6	4	7.5	16.0	304.8-368.3	12.0-14.5
25.4	1	2	345	50	65	140	27.6	4	7.5	16.0	215.9-292.1	8.5-11.5
38.0	1 1/2	3	345	50	84	180	27.6	4	9.4	20.0	177.8-190.5	7.0-7.5
50.8	2	4	345	50	105	225	27.6	4	9.4	20.0	139.7-177.8	5.5-7.0
76.2	3	5	345	50	136	290	34.5	5	12.6	27.0	127.0-165.1	5.0-6.5
101.6	4	5	414	60	155	330	34.5	5	12.6	27.0	101.6-127.0	4.0-5.0
127.0	5	6	345	50	169	360	41.4	6	16.9	36.0	88.9-114.3	3.5-4.5
152.4	6	6	380	55	183	390	41.4	6	16.9	36.0	76.2-101.6	3.0-4.0
203.2	8	7	414	60	253	540	48.3	7	21.0	45.0	63.5-88.9	2.5-3.5
254.0	10	7	483	70	293	625	48.3	7	21.0	45.0	50.8-76.2	2.0-3.0
304.8	12	8	483	70	357	760	48.3	7	21.0	45.0	38.1-50.8	1.5-2.0

[1] *Gas pressures shown are for 7.62 m of 6 mm (25 feet of 1/4 in.) diameter hose. For different hose lengths and/or diameters, consult the pressure drop tables in this guide.*

FLAMAL™ 29 Cutting Pressures[1] and Consumptions

APPROXIMATE TIP SIZES, CUTTING SPEEDS AND GAS PRESSURES FOR STYLE FS GENERAL PURPOSE TIPS												
METAL THICKNESS		TIP SIZE	OXYGEN PRESSURE		OXYGEN CONSUMPTION		FLAMAL 29 PRESSURE		FLAMAL 29 CONSUMPTION		CUTTING SPEED PER MINUTE	
mm	in.		kPa	psi	L/min	cfh	kPa	psi	L/min	cfh	mm	in.
4.7	3/16	68	241	35	21.0	45	27.6	4	1.8	4	610-762	24-30
6.0	1/4	68	310	45	23.5	50	27.6	4	1.8	4	559-711	22-28
9.5	3/8	65	310	45	30.5	65	34.5	5	1.8	4	533-686	21-27
13.0	1/2	60	345	50	35.0	75	34.5	5	1.8	4	508-660	20-26
19.0	3/4	56	345	50	44.0	95	34.5	5	1.8	4	406-533	16-21
25.4	1	56	414	60	49.0	105	34.5	5	1.8	4	356-483	14-19
31.7	1 1/4	54	414	60	79.0	170	41.4	6	3.2	7	330-457	13-18
38.0	1 1/2	54	414	60	79.0	170	41.4	6	3.2	7	305-406	12-16
50.8	2	52	414	60	94.0	200	41.4	6	3.2	7	254-356	10-14
76.2	3	49	483	70	141.0	300	55.2	8	3.2	7	203-279	8-11
127.0	5	44	552	80	211.0	450	69.0	10	4.7	10	152-229	6-9
203.2	8	38	552	80	272.0	580	69.0	10	7.5	16	102-152	4-6
254.0	10	31	621	90	291.0	620	110.0	16	7.5	16	76-127	3-5
STYLE FH HIGH SPEED TIPS FOR MACHINE TORCHES												
6.0	1/4	65	552	80	25.0	55	27.6	4	1.8	4	635-813	25-32
9.5	3/8	65	586	85	30.5	65	27.6	4	1.8	4	584-762	23-30
13.0	1/2	60	621	90	47.0	100	34.5	5	1.8	4	559-737	22-29
19.0	3/4	56	621	90	61.0	130	48.3	7	4.7	10	508-660	20-26
25.4	1	56	621	90	61.0	130	48.3	7	4.7	10	457-610	18-24
38.0	1 1/2	54	621	90	89.0	190	48.3	7	4.7	10	381-508	15-20
50.8	2	52	621	90	122.0	260	48.3	7	4.7	10	356-483	14-19
76.2	3	49	621	90	188.0	400	62.1	9	6.1	13	254-356	10-14
101.6	4	44	621	90	211.0	450	75.9	11	6.1	13	229-330	9-13
152.4	6	44	621	90	258.0	550	82.8	12	6.1	13	178-279	7-11

Multi-Flame Heating Tip Pressures[1] and Consumptions

TIP STYLE	TIP SIZE	OXYGEN PRESSURE		ACETYLENE PRESSURE		FLAMAL 29 PRESSURE		FUEL CONSUMPTION[2]	
		kPa	psi	kPa	psi	kPa	psi	L/min	cfh
735	6	41.4	6	34.5	5			15.04	32
	8	55.2	8	48.3	7			25.85	55
	10	69.0	10	62.1	9			39.95	85
738	2	55.2	8	48.3	7			79.9	170
740	10	69.0	10	62.1	9			39.95	85
	14	82.8	12	75.9	11			65.8	140
742	6	41.4	6	34.5	5			15.04	32
	8	55.2	8	48.3	7			25.85	55
	10	69.0	10	62.1	9			39.95	85
	14	82.8	12	75.9	11			65.8	140
2290 HPM	1	227.7	33			124.2	18	58.75	125
	2	276.0	40			151.8	22	79.9	170
	3	324.3	47			172.5	25	98.7	210
	4	372.6	54			227.7	33	124.5	265
	5	420.9	61			255.3	37	150.4	320

[2] *NOTE: Oxygen consumption is roughly*

- *1.1 times that of acetylene*
- *4.5 times that of propane*
- *2 times that of natural gas*
- *3.5 times that of FLAMAL 29*

For BTU/hr heat output, multiply fuel consumption (cfh) by the appropriate factor listed

- *Acetylene 1470 BTU/ft³*
- *Propane 2498 BTU/ft³*
- *Natural gas 1000 BTU/ft³*
- *FLAMAL 29 2371 BTU/ft³*

At no time should the withdrawal rate from an acetylene cylinder exceed 1/7 of the cylinder's capacity per hour. Multiple cylinders should be manifolded if this rate is exceeded.

Withdrawal rate from FLAMAL 29 cylinders is limited by the vapourization rate of the cylinder size being used, at the particular ambient temperature. Multiple cylinders should be manifolded if required flow exceeds the flow capacity of a single cylinder. Do NOT exceed 45 L/min (95 cfh) from a single size 65 FLAMAL 29 cylinder or 60 L/min (127 cfh) from a single size 108, at 20°C. Flow capacity is lower at lower temperatures.

Acetylene Welding Pressures[1] and Consumptions[3]

APPROXIMATE TIP SIZES AND GAS PRESSURES FOR BLUESHIELD WELDING TORCHES AND TIPS								
METAL THICKNESS		TIP SIZE	OXYGEN AND ACETYLENE PRESSURE		ACETYLENE CONSUMPTION		OXYGEN CONSUMPTION	
mm	in.		kPa	psi	L/min	cfh	L/min	cfh
0.4	1/64	00	6.9	1	0.047	0.1	0.047	0.1
0.8	1/32	0	6.9	1	0.188	0.4	0.188	0.4
1.6	1/16	1	6.9	1	0.47	1.0	0.517	1.1
2.5	3/32	2	13.8	2	0.94	2.0	1.034	2.2
3.2	1/8	3	20.7	3	3.76	8.0	1.136	8.8
5.0	3/16	4	27.6	4	7.99	17.0	8.46	18.0
6.0	1/4	5	34.5	5	11.75	25.0	12.69	27.0
8.0	5/16	6	41.4	6	15.98	34.0	17.39	37.0
9.5	3/8	7	48.3	7	20.21	43.0	22.09	47.0
13.0	1/2	8	55.2	8	24.44	52.0	26.79	57.0
16.0	5/8	9	62.1	9	27.73	59.0	30.08	64.0
19.0	3/4	10	69.0	10	31.49	67.0	34.31	73.0

[3] *Pressures and consumptions shown are approximate for both separate tips with appropriate mixers and for tip-mixer assemblies.*

Safety tips

- Momentarily "crack" cylinder valves to blow out dust before attaching regulators (except fuel gas cylinders).
- Back out the regulator adjusting knob before opening cylinder valve.
- Stand on opposite side of cylinder from the regulator, with valve pointing away, when opening cylinder valve.
- Open cylinder valve very slowly.
- Never light the torch before purging each hose line independently. Purge the oxygen line first, then the fuel gas line.
- Light the fuel gas first, then open the torch oxygen valve.
- Close the torch oxygen valve first when shutting down.
- Never use oil or grease on any oxy-fuel gas welding and cutting equipment.
- Never use acetylene at pressures above 103.5 kPa (15 psig).
- Do not use oxygen as a substitute for air.

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