BAB V

KESIMPULAN DAN SARAN

5.1 Kesimpulan

Berdasarkan proses pengujian dan analisa dari hasil percobaan pengujian tarik yang telah dilakukan, maka didapatkan beberapa kesimpulan, antara lain :

1. Pada uji coba ini kita menguji ketahanan bahan materialnya sejauh mana pertambahan panjangnya dan bagaimana bahan tersebut bereaksi terhadap tarikan, berdasarkan hasil percobaan dan dari grafik kurva uji tarik, alumunium mengalami perpanjangan lebih kecil yaitu (2 mm),besi (3,5 mm) dan tembaga (2,5 mm^2) dikarnakan sifat dari alumunium yang rendah terhadap tarikan dibanding besi dan tembaga.
2. Jenis material yang berbeda, dengan perlakuan yang didapatkannya berbeda dan komposisinya yang berbeda akan menyebabkan nilai tegangan pada saat putus yang berbeda pula pada besi (419,34 N/mm^2), alumunium (265,11 N/mm^2) sedangkan pada tembaga (301,73 N/mm^2).
3. Kekuatan tarik pada spesimen besi lebih besar yaitu (554,17 N/mm^2) dibandingkan kekuatan tarik pada alumunium (348,36 N/mm^2) dan tembaga (444,36 N/mm^2).
4. Sesuai dengan desain dan perancangan awal, alat uji tarik sistem pneumatik ini memiliki batas maksimal gaya tarik sampai dengan 1 ton.

5.2 Saran

Setelah melakukan pengujian dan analisa alat uji tarik sistem pnumatik penulis dapat memberikan saran sebagai berikut:

1. Untuk pengambilan data agar lebih mudah alat uji tarik harus dilengkapi dengan monitor yang mana langsung menampilkan kurva hasil uji tarik, sehingga kesalahan dalam membuat kurva uji tarik dapat diminimalisir.
2. Penambahan spesifikasi pada silinder pnumatik agar dapat menggunakan spesimen yang lebih besar dibanding pada saat ini.
3. Penyediaan kompresor yang memiliki spesifikasi lebih besar agar dapat menghasilkan tekanan angin minimal 6 bar.

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LAMPIRAN

Data Hasil Perhitungan Pada Spesimen Alumunium Dan Tembaga

1. **Spesimen Alumunium**

- Kekuatan Tarik (S_t)

$$S_t = \frac{P\,maks}{A0}$$

$$Ao = \frac{\pi.d^2}{4} = \frac{\pi.(2{,}50)^2}{4} = 4{,}9\ mm^2$$

$$S_t = \frac{1707{,}01\ N}{4{,}9mm^2}$$

$S_t = 348{,}36\ N/mm^2$

- Tegangan luluh (σ_y)

Tegangan luluh dapat dicari dengan melihat grafik tegangan regangan dengan cara metode *offset*, diketahui tegangan luluh pada uji tarik alumunium adalah 350,00 N/mm^2.

$\sigma_y = 350{,}00N/\ mm^2$

- Keuletan (%EL)

$$\%\ EL = \frac{(\Delta L)}{Lo} x\ 100$$

$$= \frac{(2)}{80} x\ 100$$

$=2{,}5$

- Tegangan pada saat patah (σ_f)

$$\sigma_f = \frac{F}{A0}$$

$$\sigma_f = \frac{1299{,}05\ N}{4{,}9mm^2}$$

$\sigma_f = 265{,}11\ N/mm^2$

- Modulus elastisitas (E)

  Modulus elastisitas benda dapat dicari dengan melihat kurva tegangan regangan pada daerah elastisitasnya

  $E = \frac{\sigma}{\epsilon}$

  $E = \frac{283,71 N/mm^2}{0,01501}$

  $E = 18654,23$ Mpa

- Kelentingan (U_R)

  $U_R = \frac{\sigma_{y^2}}{2E}$

  $U_R = \frac{350,00^2\ N/mm^2}{2x18654,23}$

  $U_R = 5,232\ N/mm^2$

- Ketangguhan (U_t)

  $U_t = S_t . \%E L$

  $U_t = 348,36x \frac{2,5}{100}$

  $U_t = 8,70\ J/mm^2$

2. Spesimen Tembaga

- Kekuatan Tarik (S_t)

$$S_t = \frac{P\ maks}{A0}$$

$$Ao = \frac{\pi.d^2}{4} = \frac{\pi.(2{,}50)^2}{4} = 4{,}9\ mm^2$$

$$S_t = \frac{2177{,}39\ N}{4{,}9mm^2}$$

$S_t = 444{,}36\ N/mm^2$

- Tegangan luluh (σ_y)

Tegangan luluh dapat dicari dengan melihat grafik tegangan regangan dengan cara metode *offset*, diketahui tegangan luluh pada uji tarik tembaga adalah 412,73 N/mm^2.

$\sigma_y = 421{,}73\ N/mm^2$

- Keuletan (%EL)

$$\%\ EL = \frac{(\Delta L)}{Lo} x\ 100$$

$$= \frac{(2{,}5)}{80} x\ 100$$

$= 3{,}12$

- Tegangan pada saat patah (σ_f)

$$\sigma_f = \frac{F}{A0}$$

$$\sigma_f = \frac{1478{,}31N}{4{,}9mm^2}$$

$\sigma_f = 301{,}73\ N/mm^2$

- Modulus elastisitas (E)

  Modulus elastisitas benda dapat dicari dengan melihat kurva tegangan regangan pada daerah elastisitasnya

  $$E = \frac{\sigma}{\varepsilon}$$

  $$E = \frac{182,58 N/mm^2}{0,00925}$$

  $$E = 9172,5 \text{ Mpa}$$

- Kelentingan (U_R)

  $$U_R = \frac{\sigma_{y^2}}{2E}$$

  $$U_R = \frac{412,73^2 \ N/mm^2}{2x9172,5}$$

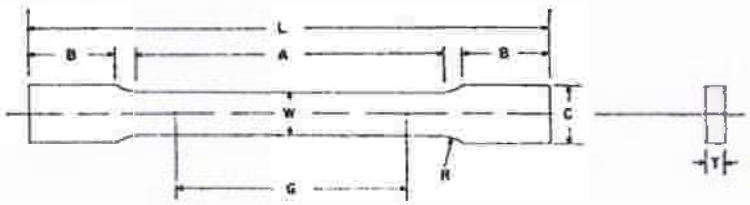
  $$U_R = 51,20 \text{ N/mm}^2$$

- Ketangguhan (U_t)

  $$U_t = S_t . \%EL$$

  $$U_t = 444,36 \text{ x } \frac{3,12}{100}$$

  $$U_t = 13,86 \text{ J/mm}^2$$



DIMENSIONS

	Standard Specimens				Subsize Specimen	
	Plate-Type, 1½-in. Wide		Sheet-Type, ½-in. Wide		¼-in. Wide	
	in.	mm	in	mm	in.	mm
G-Gage length (Notes 1 and 2)	8.00 ± 0.01	200 ± 0.25	2.000 ± 0.005	50.0 ± 0.10	1.000 ± 0.003	25.0 ± 0.08
W-Width (Notes 3, 5, and 6)	1½ + ⅛ − ¼	40 + 3 − 6	0.500 ± 0.010	12.5 ± 0.25	0.250 ± 0.002	6.25 ± 0.05
T-Thickness (Note 7)	thickness of material					
R-Radius of fillet, min (Note 4)	½	13	½	13	¼	6
Over-all length, min (Notes 2 and 8)	18	450	8	200	4	100
A-Length of reduced section, min	9	225	2¼	60	1¼	32
B-Length of grip section, min (Note 9)	3	75	2	50	1¼	32
C-Width of grip section, approximate (Notes 4, 10, and 11)	2	50	¾	20	⅜	10

NOTE 1—For the 1½-in. (40-mm) wide specimen, punch marks for measuring elongation after fracture shall be made on the flat or on the edge of the ecimen and within the reduced section. Either a set of nine or more punch marks 1 in. (25 mm) apart, or one or more pairs of punch marks 8 in. (200 n) apart may be used.

NOTE 2—For the ½-in. (12.5-mm) wide specimen, gage marks for measuring the elongation after fracture shall be made on the ½-inch (12.5-mm) face on the edge of the specimen and within the reduced section. Either a set of three or more marks 1.0 in. (25 mm) apart or one or more pairs of marks n. (50 mm) apart may be used.

NOTE 3—For the three sizes of specimens, the ends of the reduced section shall not differ in width by more than 0.004, 0.002 or 0.001 in. (0.10, 0.05 0.025 mm), respectively. Also, there may be a gradual decrease in width from the ends to the center, but the width at either end shall not be more than 015 in., 0.005 in., or 0.003 in. (0.40, 0.10 or 0.08 mm), respectively, larger than the width at the center.

NOTE 4—For each specimen type, the radii of all fillets shall be equal to each other with a tolerance of 0.05 in. (1.25 mm), and the centers of curvature the two fillets at a particular end shall be located across from each other (on a line perpendicular to the centerline) within a tolerance of 0.10 in. (2.5 m).

NOTE 5—For each of the three sizes of specimens, narrower widths (*W* and *C*) may be used when necessary. In such cases the width of the reduced ction should be as large as the width of the material being tested permits; however, unless stated specifically, the requirements for elongation in a product ecification shall not apply when these narrower specimens are used. If the width of the material is less than *W*, the sides may be parallel throughout e length of the specimen.

NOTE 6—The specimen may be modified by making the sides parallel throughout the length of the specimen, the width and tolerances being the same those specified above. When necessary a narrower specimen may be used, in which case the width should be as great as the width of the material being sted permits. If the width is 1½ in. (38 mm) or less, the sides may be parallel throughout the length of the specimen.

NOTE 7—The dimension *T* is the thickness of the test specimen as provided for in the applicable material specifications. Minimum nominal thickness 1½-in. (40-mm) wide specimens shall be 5/16 in. (5 mm), except as permitted by the product specification. Maximum nominal thickness of ½-in. 2.5-mm) and ¼-in. (6-mm) wide specimens shall be ¾in. (19 mm) and ¼ in. (6 mm), respectively.

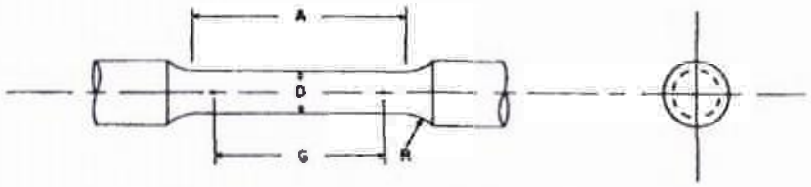
NOTE 8—To aid in obtaining axial loading during testing of ¼-in. (6-mm) wide specimens, the over-all length should be as the material will permit.

NOTE 9—It is desirable, if possible, to make the length of the grip section large enough to allow the specimen to extend into the grips a distance equal two thirds or more of the length of the grips. If the thickness of ½-in. (13-mm) wide specimens is over ⅜ in. (10 mm), longer grips and correspondingly nger grip sections of the specimen may be necessary to prevent failure in the grip section.

NOTE 10—For standard sheet-type specimens and subsize specimens the ends of the specimen shall be symmetrical with the center line of the reduced ction within 0.01 and 0.005 in. (0.25 and 0.13 mm), respectively. However, for steel if the ends of the ½-in. (12.5-mm) wide specimen are symmetrical ithin 0.05 in. (1.0 mm) a specimen may be considered satisfactory for all but referee testing.

NOTE 11—For standard plate-type specimens the ends of the specimen shall be symmetrical with the center line of the reduced section within 0.25 in. .35 mm) except for referee testing in which case the ends of the specimen shall be symmetrical with the center line of the reduced section within 0.10 . (2.5 mm).

FIG. 3 Rectangular Tension Test Specimens



DIMENSIONS

Nominal Diameter	Standard Specimen		Small-Size Specimens Proportional to Standard							
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
	0.500	12.5	0.350	8.75	0.250	6.25	0.160	4.00	0.113	2.50
Gage length	2.00 ± 0.005	50.0 ± 0.10	1.400 ± 0.005	35.0 ± 0.10	1.000 ± 0.005	25.0 ± 0.10	0.640 ± 0.005	16.0 ± 0.10	0.450 ± 0.005	10.0 ± 0.10
Diameter (Note 1)	0.500 ± 0.010	12.5 ± 0.25	0.350 ± 0.007	8.75 ± 0.18	0.250 ± 0.005	6.25 ± 0.12	0.160 ± 0.003	4.00 ± 0.08	0.113 ± 0.002	2.50 ± 0.05
Radius of fillet, min	3/8	10	1/4	6	3/16	5	5/32	4	3/32	2
Length of reduced section, min (Note 2)	2 1/4	60	1 3/4	45	1 1/4	32	3/4	20	5/8	16

NOTE 1—The reduced section may have a gradual taper from the ends toward the center, with the ends not more than 1 percent larger in diameter than the center (controlling dimension).

NOTE 2—If desired, the length of the reduced section may be increased to accommodate an extensometer of any convenient gage length. Reference marks for the measurement of elongation should, nevertheless, be spaced at the indicated gage length.

NOTE 3—The gage length and fillets shall be as shown but the ends may be of any form to fit the holders of the testing machine in such a way that the load shall be axial (see Fig. 9). If the ends are to be held in wedge grips it is desirable, if possible, to make the length of the grip section great enough to allow the specimen to extend into the grips a distance equal to two thirds or more of the length of the grips.

NOTE 4—On the round specimens in Fig. 5 and Fig. 6, the gage lengths are equal to four times the nominal diameter. In some product specifications other specimens may be provided for, but unless the 4-to-1 ratio is maintained within dimensional tolerances, the elongation values may not be comparable with those obtained from the standard test specimen.

NOTE 5—The use of specimens smaller than 0.250-in. (6.25-mm) diameter shall be restricted to cases when the material to be tested is of insufficient size to obtain larger specimens or when all parties agree to their use for acceptance testing. Smaller specimens require suitable equipment and greater skill in both machining and testing.

NOTE 6—Five sizes of specimens often used have diameters of approximately 0.505, 0.357, 0.252, 0.160, and 0.113 in., the reason being to permit easy calculations of stress from loads, since the corresponding cross sectional areas are equal or close to 0.200, 0.100, 0.0500, 0.0200, and 0.0100 $in.^2$, respectively. Thus, when the actual diameters agree with these values, the stresses (or strengths) may be computed using the simple multiplying factors 1, 10, 20 50, and 100, respectively. (The metric equivalents of these fixed diameters do not result in correspondingly convenient cross sectional area and multiplying factors.)

FIG. 4 Standard 0.500-in. (12.5-mm) Round Tension Test Specimen with 2-in. (50-mm) Gage Length and Examples of Small-Size Specimens Proportional to the Standard Specimens