



ENGINEERING STANDARD



SUBJECT	DATE	PAGE	NUMBER
SQUARE KEYS	12/2010	1	NA2.25.2

This standard covers square headless parallel (as opposed to taper) keys.

Since the principal shaft load in key applications is torsional and the relation of ultimate shear stress to ultimate bearing stress is 1:2, only shear stress in the key and torsional shear stress in the shaft will be considered in this standard. The designer will have to consider combined stresses in the shaft.

I. CALCULATIONS

A. SHAFT

Elastic shear stress, torsion (S_s) = 63% of Min. Yield

S_s - CD Round AISI 1018 = 34,020 PSI (1" Round)

S_s - CD Round AISI 1045 = 48,510 PSI (1" Round)

B. KEY

Material: AISI 1018 Key Stock

Elastic Shear Stress (S_k): 39,803 PSI*

* Literature and tests show that keystock is 17% stronger than C.D. Round (1" Dia.)

C. CALCULATIONS

Shaft

$$T_s = \frac{S_s \times \pi \times D^3 \times K}{16}$$

T_s = Torque Capacity – Shaft
 S_s = Elastic Shear Stress (Section A)
 D = Shaft Diameter
 K = Key Factor = .75

Key

$$T_k = S_k \times A \times R$$

$$A = W \times L$$

$$R = \sqrt{r^2 - \left(\frac{W}{2}\right)^2}$$

$$L = \frac{T_k}{S_k \times W \times R}$$

T_k = Torque Capacity – Key
 S_k = Elastic Shear Stress 39,803
 R = Effective Radius of Shear
 A = Shear area of key
 W = Key width = Key height
 L = Key length
 r = Shaft radius

FILE NO.

Rev. B



ENGINEERING STANDARD

SUBJECT

SQUARE KEYS

DATE

12/2010

PAGE

3

NUMBER

NA2.25.2

TORQUE CAPACITIES in inch pounds

Key capacity compared with (2) grades of cold drawn bar (Figures at bottom)
KEYS T_k

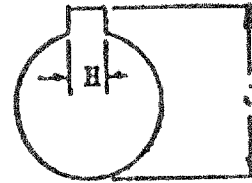
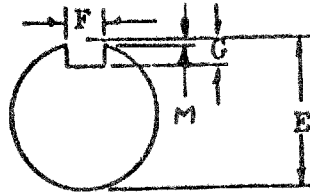
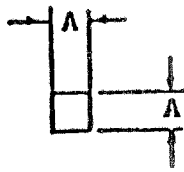
Key Size & P.N.	SHAFT DIAMETER									
	.75	.88	1.00	1.12	1.25	1.38	1.50	1.62	1.75	2.00
.19 X .75 87473	2032	2392	2749	3105						
.19 X 1.00 87474	2710	3189	3665	4139						
.19 X 1.25 87475	3387	3987	4582	5174						
.19 X 1.50 87476	4065	4784	5489	6209						
.25 X 1.00 87477			4817	5457	6094	6727	7359			
.25 X 1.25 86628576			6022	6822	7617	8409	9198			
.25 X 1.50 87479			7226	8186	9140	10091	11038			
.25 X 1.75 87480			8431	9550	10664	11773	12878			
.25 X 2.00 87481			9635	10915	12187	13454	14717			
.25 X 2.50 87497			12043	13643	15234	16818	18397			
.31 X 1.25 87482					9409	10410	11405	12397	13386	
.31 X 1.50 87483					11291	12492	13686	14876	16063	
.31 X 1.75 87484					13173	14573	15967	17356	18740	
.31 X 2.00 87485					15054	16655	18248	19835	21417	
.31 X 2.50 87495					18818	20819	22810	24794	26772	
.38 X 1.50 86977757							16259	17700	19136	21992
.38 X 1.75 84404453							18969	20650	22325	25658
.38 X 2.50 87496							27098	29500	31893	36654
.38 X 4.00 87492							43356	47201	51028	58646
.50 X 1.75 87488									29204	33722
.50 X 2.50 87489									41720	48174
.50 X 3.00 87490									50064	57809

Shaft Grade (T_s)

1018	2114	3356	5010	7133	9785	13024	16909	21498	26851	40080
1045	3014	4786	7144	10172	13953	18572	24111	30655	38287	57152

FILE NO.

Rev. B

TABULATED DIMENSIONS OF KEYSLOTS AND KEYWAYS


SIZE A		NOM SHAFT DIA								
Max.	Min.		F		G		H		J	
		E	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
.1885	.1875	.75	.187	.189	.104	.109	.189	.191	.838	.843
		.88			.102	.107			.964	.969
		1.00			.101	.106			1.091	1.096
		1.12			.100	.105			1.217	1.222
.251	.250	1.00	.249	.251	.139	.144	.251	.253	1.115	1.120
		1.12			.137	.142			1.242	1.247
		1.25			.136	.141			1.368	1.373
		1.38			.134	.139			1.495	1.500
		1.50			.133	.138			1.621	1.626
.3135	.3125	1.25	.312	.314	.174	.179	.314	.316	1.392	1.397
		1.38			.172	.177			1.519	1.524
		1.50			.171	.176			1.646	1.651
		1.62			.169	.174			1.772	1.777
		1.75			.168	.173			1.898	1.903
.376	.375	1.50	.374	.376	.209	.214	.376	.378	1.670	1.675
		1.62			.207	.212			1.797	1.802
		1.75			.206	.211			1.923	1.928
		2.00			.203	.208			2.176	2.181
.501	.500	1.75	.499	.501	.284	.289	.501	.503	1.969	1.974
		2.00			.280	.285			2.224	2.229

FORMULAS:

SLOT IN SHAFT — "G"

$$G = \frac{A(\text{Min.})}{2} + M \begin{cases} - .002 \text{ Min.} \\ + .003 \text{ Max.} \end{cases}$$

M = VERSED SINE

$$M = \frac{E}{2} - \sqrt{\left(\frac{E}{2}\right)^2 - \left(\frac{A(\text{Min.})}{2}\right)^2}$$

(See Std. 2.25.1 page 6)

HUB SLOT — DIM. "J"

$$J = A(\text{Max.}) - G(\text{Min.}) + E(\text{Nom.}) \begin{cases} + .003 \text{ Min.} \\ + .008 \text{ Max.} \end{cases}$$

M = Versed sine, is the distance the edge of the keyslot is below the outside of the shaft measured parallel to the sides of the key.

FILE NO.

Rev. B