WISELearn Resources

Career Academy Teacher Externship Program

Title: Tapping Metric to Standard Threads

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Externship Business: Nicolet Plastics

Overview / Description:

Students should be able to determine and use the correct size drill and tap to make a threaded internal thread.

Subject(s):

Technology Education, Physics

Grade Level(s):

9-12-Technology Education

Learning goals/objectives:

After completing this activity, students should be able to:

- pick the correct size drill bit to make the appropriate size holes for tapping different threads
- understand and appreciate sizes in fractions, decimal, metric, standard, letter and number size discriminations

Type of Activity:

- Individual

Teaching Strategies:

- Discussion
- Use of Technology
- Simulation
- Performance Assessment

Content Standards:

WIsconsin Standards for Technology and Engineering

Content Area: MNF/Manufacturing:

Standard: MNF1: Students will be able to select and use manufacturing technologies.

MNF1.a: Identify, select and safely use tools, machines, products and systems for specific tasks.

MNF1.a.2.e: Recognize tools, machines and materials along with their applications and failures.
MNF1.a.3.e: Recognize the characteristics of length, volume, weight, area and time.
MNF1.a.5.m: Use tools, materials and machines safely to diagnose, adjust and repair systems.
MNF1.a.6.m: Explore both customary and metric systems of measurement and conversions.
MNF1.a.9.h: Select and apply the apply the appropriate units and scales for situations involving measurement.

Model Academic Standards for School Counseling

Academic Development Domain

Content Standard C: Students will understand the relationship of academics to the world of work, and to life at home and in the community.

Core Performance Standard 1: Understand how to relate school to life experiences.

Length of Time and length of class periods:

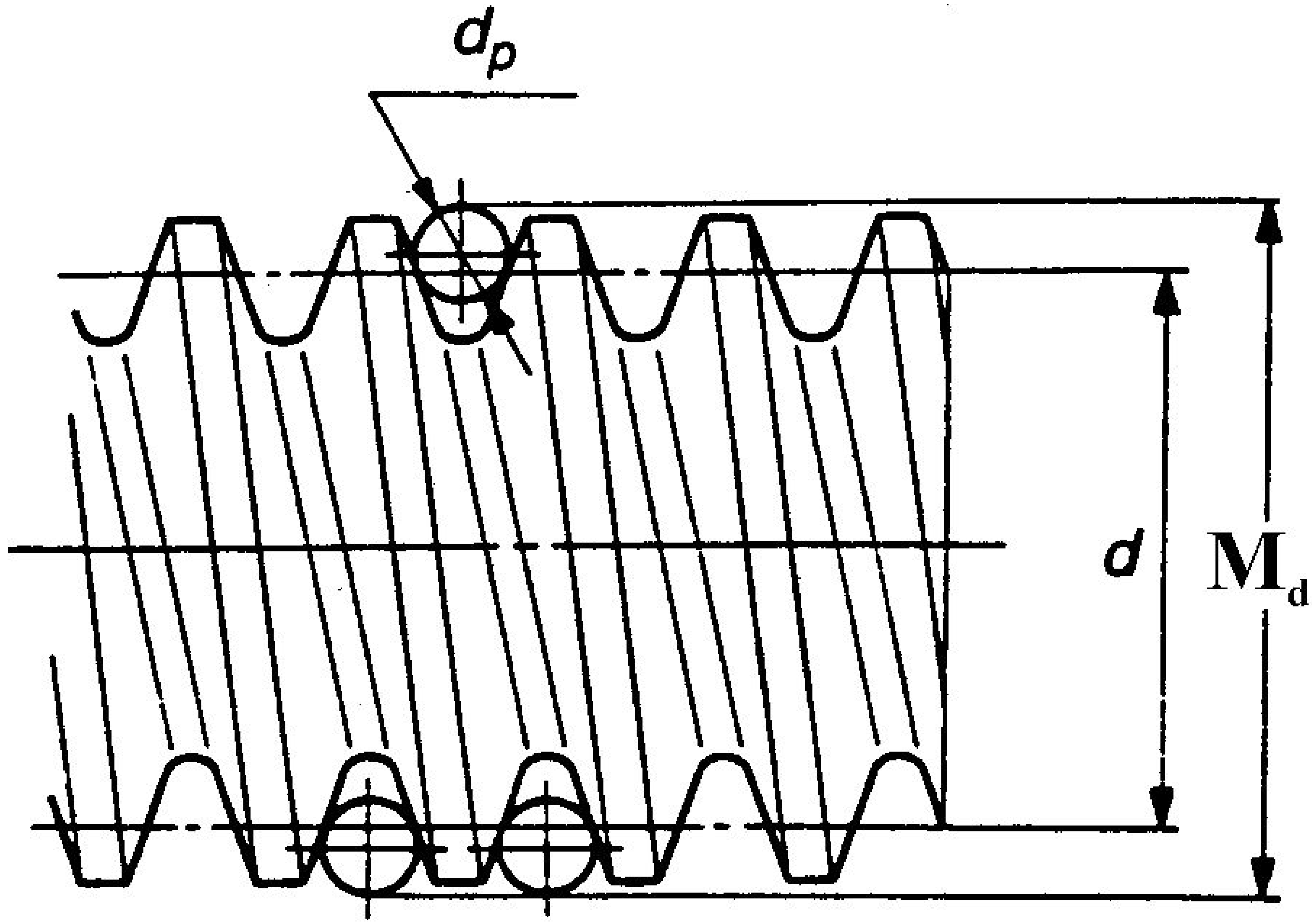
1 to 2 class periods

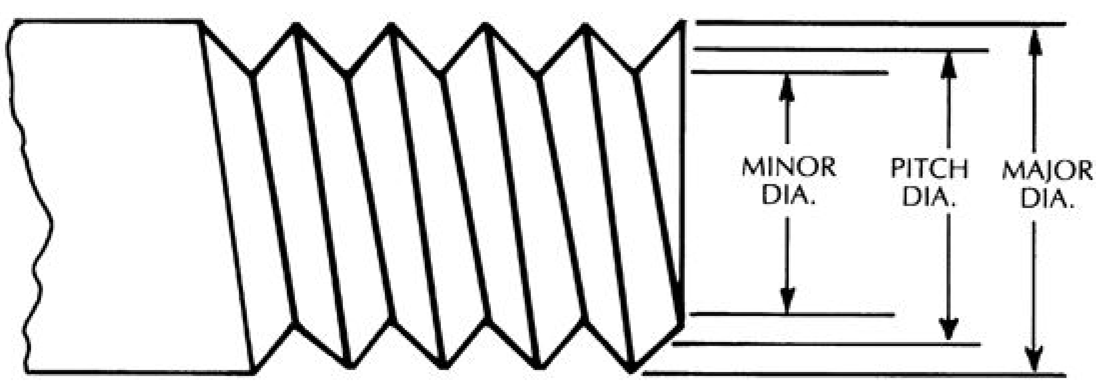
Materials List (linked if online resource please):

- Starrett Tap Chart - http://www.starrett.com/docs/educational/decimal-equivalent-card---bulletin-1317.pdf
- Taps Technical Information: https://www.mscdirect.com/basicsof/taps
- External Acme Thread Dimensions Table: https://www.amesweb.info/Screws/External-Acme-Thread-Dimensions-Table.aspx
- Machinery's Handbook: http://www.nashua.edu/paradisem1/Machinery's%20Handbook%2027th/27_Prop_03.pdf

Table 3. *(Continued)* **Standard Series and Selected Combinations — Unified Screw Threads**

Nominal Size, Threads per Inch, and Series Designation[a]	External[b]								Internal[b]					
	Class	Allowance	Major Diameter			Pitch Diameter		UNR Minor Dia.,[c] Max (Ref.)	Class	Minor Diameter		Pitch Diameter		Major Diameter
			Max[d]	Min	Min[e]	Max[d]	Min			Min	Max	Min	Max	Min
10–24 UNC	2A	0.0010	0.1890	0.1818	—	0.1619	0.1586	0.1394	2B	0.145	0.156	0.1629	0.1672	0.1900
	3A	0.0000	0.1900	0.1828	—	0.1629	0.1604	0.1404	3B	0.1450	0.1555	0.1629	0.1661	0.1900
10–28 UNS	2A	0.0010	0.1890	0.1825	—	0.1658	0.1625	0.1464	2B	0.151	0.160	0.1668	0.1711	0.1900
10–32 UNF	2A	0.0009	0.1891	0.1831	—	0.1688	0.1658	0.1519	2B	0.156	0.164	0.1697	0.1736	0.1900
	3A	0.0000	0.1900	0.1840	—	0.1697	0.1674	0.1528	3B	0.1560	0.1641	0.1697	0.1726	0.1900
10–36 UNS	2A	0.0009	0.1891	0.1836	—	0.1711	0.1681	0.1560	2B	0.160	0.166	0.1720	0.1759	0.1900
10–40 UNS	2A	0.0009	0.1891	0.1840	—	0.1729	0.1700	0.1592	2B	0.163	0.169	0.1738	0.1775	0.1900
10–48 UNS	2A	0.0008	0.1892	0.1847	—	0.1757	0.1731	0.1644	2B	0.167	0.172	0.1765	0.1799	0.1900
10–56 UNS	2A	0.0007	0.1893	0.1852	—	0.1777	0.1752	0.1681	2B	0.171	0.175	0.1784	0.1816	0.1900
12–24 UNC	2A	0.0010	0.2150	0.2078	—	0.1879	0.1845	0.1654	2B	0.171	0.181	0.1889	0.1933	0.2160
	3A	0.0000	0.2160	0.2088	—	0.1889	0.1863	0.1664	3B	0.1710	0.1807	0.1889	0.1922	0.2160
12–28 UNF	2A	0.0010	0.2150	0.2085	—	0.1918	0.1886	0.1724	2B	0.177	0.186	0.1928	0.1970	0.2160
	3A	0.0000	0.2160	0.2095	—	0.1928	0.1904	0.1734	3B	0.1770	0.1857	0.1928	0.1959	0.2160
12–32 UNEF	2A	0.0009	0.2151	0.2091	—	0.1948	0.1917	0.1779	2B	0.182	0.190	0.1957	0.1998	0.2160
	3A	0.0000	0.2160	0.2100	—	0.1957	0.1933	0.1788	3B	0.1820	0.1895	0.1957	0.1988	0.2160
12–36 UNS	2A	0.0009	0.2151	0.2096	—	0.1971	0.1941	0.1821	2B	0.186	0.192	0.1980	0.2019	0.2160
12–40 UNS	2A	0.0009	0.2151	0.2100	—	0.1989	0.1960	0.1835	2B	0.189	0.195	0.1998	0.2035	0.2160
12–48 UNS	2A	0.0008	0.2152	0.2107	—	0.2017	0.1991	0.1904	2B	0.193	0.198	0.2025	0.2059	0.2160
12–56 UNS	2A	0.0007	0.2153	0.2112	—	0.2037	0.2012	0.1941	2B	0.197	0.201	0.2044	0.2076	0.2160
1/4–20 UNC	1A	0.0011	0.2489	0.2367	—	0.2164	0.2108	0.1894	1B	0.196	0.207	0.2175	0.2248	0.2500
	2A	0.0011	0.2489	0.2408	0.2367	0.2164	0.2127	0.1894	2B	0.196	0.207	0.2175	0.2224	0.2500
	3A	0.0000	0.2500	0.2419	—	0.2175	0.2147	0.1905	3B	0.1960	0.2067	0.2175	0.2211	0.2500
1/4–24 UNS	2A	0.0011	0.2489	0.2417	—	0.2218	0.2181	0.1993	2B	0.205	0.215	0.2229	0.2277	0.2500
1/4–27 UNS	2A	0.0010	0.2490	0.2423	—	0.2249	0.2214	0.2049	2B	0.210	0.219	0.2259	0.2304	0.2500
1/4–28 UNF	1A	0.0010	0.2490	0.2392	—	0.2258	0.2208	0.2064	1B	0.211	0.220	0.2268	0.2333	0.2500
	2A	0.0010	0.2490	0.2425	—	0.2258	0.2225	0.2064	2B	0.211	0.220	0.2268	0.2311	0.2500
	3A	0.0000	0.2500	0.2435	—	0.2268	0.2243	0.2074	3B	0.2110	0.2190	0.2268	0.2300	0.2500
1/4–32 UNEF	2A	0.0010	0.2490	0.2430	—	0.2287	0.2255	0.2118	2B	0.216	0.224	0.2297	0.2339	0.2500
	3A	0.0000	0.2500	0.2440	—	0.2297	0.2273	0.2128	3B	0.2160	0.2229	0.2297	0.2328	0.2500





<u>Directions (Step-by-Step):</u>

1. Introduction - Start with an explanation of external and Internal threads; cover types and different uses, fastening at different securement levels, percentage of threads, ease, strength, clearances and feeding at a ratio. Include an explanation of making threads, machine tapping, hand tapping, forged or rolling. You can start with internal threads of ¼-20 UNC 2B.

2. Talk about each of the digits and what its discrimination means.

3. Hand each student a Taps Technical Information page: https://www.mscdirect.com/basicsof/taps and explain what a Class 2 fit is, which is a normal machine screw fit. This is what you find if you go to Fleet Farm and buy a bag of 1/4 -20 UNC bolts.

4. Pick student's size and thread. Remember, smaller is cheaper but the success rate falls quickly if you go too small because of breakage. This is a good time to include a basic explanation of tap extractors, EDM's and helicoils.

5. Give each student a Starrett Tap Chart: http://www.starrett.com/docs/educational/decimal-equivalent-card---bulletin-1317.pdf. Tell students they should keep this in their toolbox if they have one. If available, teacher may consider laminating the Starrett Tap Chart. Direct students to find correct size drill for correct size tapped hole.

6. Drilling Procedure - Review oil, chip shape, and pressure on drill. This may be a good time to talk about drills and sharpening.

7. Show different types of taps: Machine Tap, Hand Tap, 2 fluted, 3 fluted, 4 fluted, straight fluted tap, helicoil tap.

8. Chamfers - This is a good time to talk about the internal thread max thread diameter and show what some of the categories in the machinist handbook are for and what they mean (e.g. Internal Thread Max Dia.)

9. Point out, as long as the chamfer is bigger than the internal thread dia, you will not have half a thread folding over and tearing up the rest of your threads. If it is too big, you decrease thread strength.
   a. Have a student draw a picture of what the threads would look like up close if the chafer was too small. Make sure they draw the 60 degree thread with a straight up and down face and explain that will meet the thread at the crest at some point of the dia. and you will have half a thread. This is the point that is weak and will brake.

   Talk about the different faces and parts of the thread.

10. Oil discussion - Explain viscosity and specific gravity of different oils and what they mean. Share with students the Machinery's Handbook: http://www.nashua.edu/paradisem1/Machinery's%20Handbook%2027th/27_Prop_03.pdf. Have students look at the numbers on the specific gravity chart. Have them hypothesize why would they use the different oils. Discuss how different metals react to oils because they have a different specific gravity. Explain how thicker oils work better for steel, while a liquid that is almost 50% oil and 50% alcohol works better for aluminum. Explain the connection between

evaporation rates and thicker higher numbered metals with more electrons on the outer shelves. This is why a metal such as steel needs a thick oil. It will not change states at low temperature, unlike aluminum cutting oil with the alcohol. This will deal with the higher friction, heat and evaporate at a higher temp so the metals do not temper or brake. Aluminum, with it's low specific gravity, gets heated quickly and changes states of matter quickly. This is what we are trying to control and stop with the point that evaporation occurs with our cutting oil due to friction.

11. Students should take their drilled hole and make sure chafers are good. Next, they should generously add tapping fluid. Remind students that they are hand tapping. They should start by considering straightness and pressure. As they start drilling, they should proceed forward only until they feel a fair amount of stress.

12. Once started, students should continue to turn forward ¾ to 1 turn and then give ¼ turn back to break the chips. Model to student how too much of a turn will not give the chip room to fall away through the flutes. Talk about the difference between machine taps and what helicoils are for. Talk about why when hand tapping you can never have too much tapping fluid, as it acts like a river carrying away chips.

13. Once students have had a chance to practice drilling, explain coolant, broken taps, messed up weak threads, and recutting chips and what that does to the uneven chip load of each tooth on the tap when it hits it.

14. Help students determine how far the tap should go through. Talk about the different types of taps and how different taps have a different number of tapered cutting threads. Explain how machine threads have to go through or have a minor diameter that was drilled much longer than the threads are going to go.

15. Give students a tap of the same size threads they just cut and see if it fits. Grade accordingly.

Wrap-Up:

Have students list three ways taps break and explain why. Have them drill and tap a thread independently.

Formative/Summative Assessment:

Formative Assessment - Step 9 - Have a student draw a picture of what the threads would look like up close if the chafer was too small. Make sure they draw the 60 degree thread with a straight up and down face. Either walk around to spot check student work or collect as an exit ticket.

Summative Assessment - Once students have drilled and tapped a thread, determine if the corresponding bolt will screw into the hole.

Extension Activity for differentiation:

Students may pursue more in-depth practice in any of the following topics:
-Chamfering
-Oil, viscosity and specific gravity
-Tapping pressure and feeds
-Types of taps
-Kinds, class and function of threads
-Specific gravity and periodic table
-Tap extracting
-External threads
-Percentage of thread fit
-Converting Metric to Standard Units
-Identifying parts and faces of a thread

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