Continuing Professional Development
in Vocational Education and Training

Reading and Assigning of Manufacturing Drawings

Inspiration for online teaching

COVET

In the COVET project, we have collected many great examples of teaching that have been transformed from the classic off-line version into a modern online learning method.

These sample lessons have been created by VET teachers from different EU countries. We present them to you as inspiration for your work.

The lessons are particularly suitable for vocational teachers, but can also serve as a training tool for teachers, trainers and lecturers in other educational settings.

All sample lessons, training materials as well as all information about the project are available at:
https://www.covet-project.eu/

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Reading and Assigning of Manufacturing Drawings

Off-line version of the preparation:

Goal: Students will be able to read a manufacturing drawing to produce the part shown, identify all important elements on the drawing - neck, center mark, thread, etc. They will be able to read the necessary information in the information block of the drawing. At the end of the lesson, they will understand the requirements of entering a manufacturing drawing of a specified part in a 3D view.

Teaching methods: motivational interview: why do I need to be able to read manufacturing drawings; independent work of pupils not assessed by a mark; consultation on the results of their work and communication of the correct solution; problem-based interview on how to project a given component in 3D view; and further according to the situation in the classroom

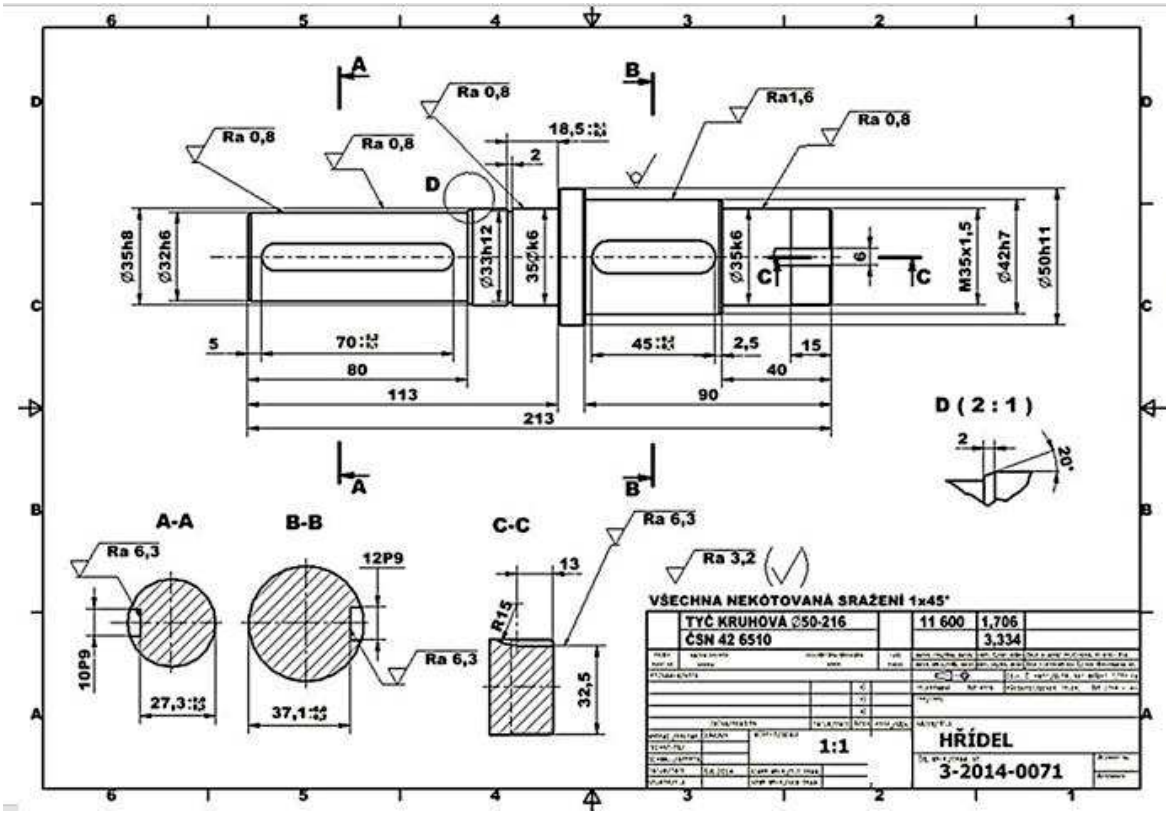
Aids:

- **Presentation with the manufacturing drawing of the SHAFT** and other slides with prepared principles of drawing of some elements on the parts
- A pump with visible shaft, journal
- Worksheet for independent work
- Wooden large projection corner - an aid for entering 3D parts
- Cut 3D shaft assignments for each student to paste into their workbooks

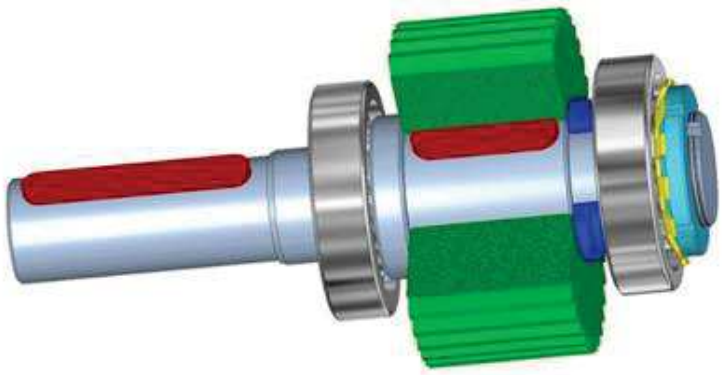
The course of activities in the lesson:

- Quick repetition of possible elements of the drawing
- Independent work - answers questions in the worksheet
- Continuous checking of individual pupils' work.
- Consultation on the correct solutions with the whole class
- 3D shaft specification
- Consultation on the correct choice of views for the shaft view and on the elements of the shaft
- We discuss how the lesson went
- This topic is very difficult to teach even face-to-face. The pupils need to combine knowledge from various subjects and they do not find it easy. But I am aware that the topic is essential for their further studies and everyday work practice. Therefore I have included or developed various „motivating techniques“. One cannot expect the students to be enthusiastic about this topic, the aim is to help the students to pay attention, learn and remember most of the information. It was very crucial in a situation when no practical classes were available and the pupils had no opportunity to learn by doing.

A sample of several slides from the *PPT* presentation showing what a complex task for the students it is:

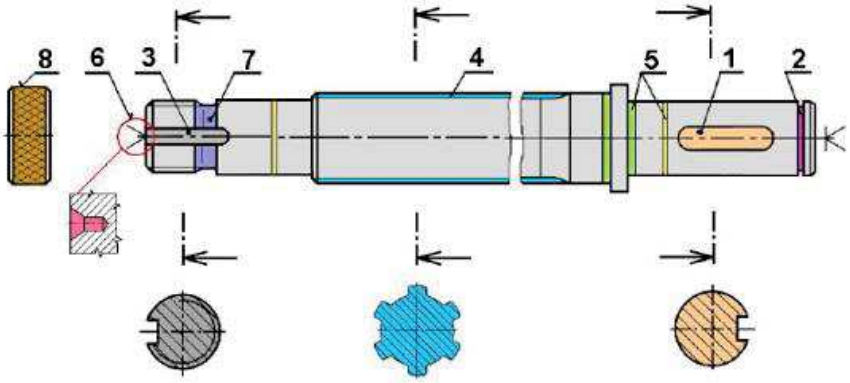


Hřídel je součástí této podsestavy převodovky.

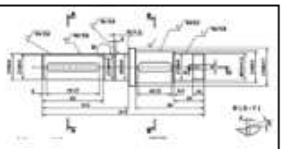


Co rozumíme tvarovými prvky hřídelů?

1. Drážky pro pera a klíny
2. Drážky pro pojistné kroužky
3. Drážky pro poj.podložky MB
4. Drážkování
5. Zápichy
6. Středící důlky
7. Drážky za závitem
8. Rýhování a vroubkování



Sample worksheet helping the students to divide the task into individual steps



Čtení výkresu HŘÍDELE 2

1. Napište **velikost polotovaru**, který zvolíte pro obrábění součásti NA VÝKRESE.

.....

2. Jaký je **materiál**, ze kterého je hřídel obroben? .....
3. Vypište všechny rozměry, které mají na výkrese **předepsané tolerance**.

.....

4. Vypište všechny rozměry, na které se vztahují **všeobecné tolerance**. Napište číslo normy Všeobecných tolerancí.

.....

5. Napište všechny rozměry, které potřebujete znát pro **výrobu drážky pro pojistný kroužek**.

.....

6. Které všechny údaje musíte znát pro **výrobu závitu** na hřídeli? K čemu **závit** na hřídeli bude **sloužit**?

.....

7. Co všechno vyčteme z **označení závitu** na konci hřídele?

.....

Online version of the preparation

We had the opportunity to work with students in school using Teams. Here we could do direct explanations through presentations shared with everyone on the screen, assign tasks and have an accurate overview of who submitted the task and when.

I had to learn how to work with Teams. Initially Teams was mainly focused on functions needed in companies, but gradually the programmers added functions needed for school teaching. So there was a constant need to learn new features and how to use them for teaching.

Unfortunately, during the second school COVID closure, instructions were issued that we actually have to imitate the frontal teaching in the school and for example check pupils' absence. It is, of course, foolish to think that this can substitute face-to-face frontal instruction. There is no direct contact and the feedback for teachers is almost non-existent. It is impossible to keep the attention of pupils who have difficulty concentrating.... When a pupil is not paying attention you repeat what is said again, when teaching online you can't tell when someone does not or cannot pay attention.... You will not even know if someone is sleeping. ☺ There were many failures of microphones, connections etc.

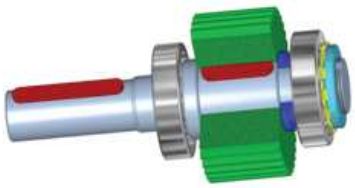
When schools closed for the first time I used my knowledge of distance learning procedures and principles and it worked much better.

For this particular lesson I redesigned the shaft drawing assignment, instead of 6 components drawn on A4, just one part and I converted it to a PDF format that everyone could open on their mobile phones or PC.

I combined the worksheet and the shaft drawing that the students "read" into one file and converted it to a PDF. I assigned them to read the drawing in the assignment in the appropriate Team. Students then wrote their answers on paper and then scanned and uploaded them into Teams. This was followed by a discussion on the correct answers, where I could view their answers from Teams and we could discuss their correctness.

As far as their drawing was concerned, in the next lesson after the deadline, we also discussed the correct drawing. It was possible to display the drawings and I **draw onto them on a graphics tablet**, which I **had to learn to use,** draw, and write with - at least a little legibly. The graphics tablet was bought for me after some minor disputes at school, because otherwise it would be very difficult to explain anything in technical subjects, especially in technical documentation. My tablet was already obsolete and had a worn tip.

Sample of one page from the drawing reading assignment going from simple to more complex tasks:



Hřídel je součástí této podsestavy převodovky.

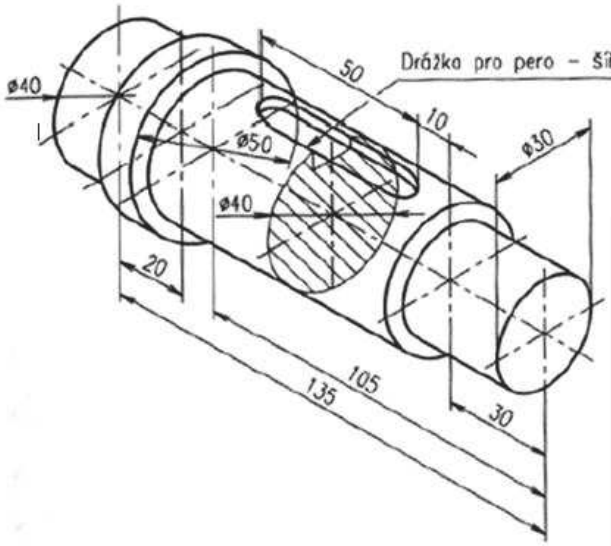
Odpovězte na otázky: odpovídejte celou větou, odpovědi napište RUČNĚ čitelným, nejlépe technickým písmem na A4 s rámečkem a **oskenujte** jako PDF (ODKAZ NA APLIKACE DO MOBILU: https://lightpdf.com/cz/skenuji-pdf-na-telefonech.html), a odevzdejte.

Na písmo si uvnitř tabulky dělejte horní i dolní linku. Písmo má mít normalizovanou velikost: 10 mm nebo 7 mm. Doporučuji 7 mm, ať to není tak veliké a dlouhé.

1. Napište **velikost polotovaru**, který zvolíte pro obrábění této součásti.
2. Jaký je **materiál**, ze kterého je hřídel obroben?
3. Vypište všechny rozměry, které mají na výkrese **předepsané tolerance**.
4. Vypište všechny rozměry, na které se vztahují **všeobecné tolerance**. Napište číslo normy Všeobecných tolerancí.
5. Napište všechny rozměry, které potřebujete znát pro **výrobu drážky pro pojistný kroužek**.
6. Které všechny údaje musíte znát pro **výrobu závitu** na hřídeli? K čemu **závit** na hřídeli bude **sloužit**?
7. Co všechno vyčteme z **označení závitu** na konci hřídele?
8. Které všechny průměry budou muset **být broušeny**, pokud hřídel vyrábíme na **konvenčních strojích** (ne na CNC)?
9. Jakou **drsnost** povrchu budou mít **boky** všech **frézovaných drážek**?
10. Jakou drsnost **dna drážky** bude mít drážka **pro MB podložku**?
11. Jaké všechny rozměry musíte mít na zřeteli, abyste správně **vyrobili obě drážky pro pero**?

Shift is an element of this part of gearbox

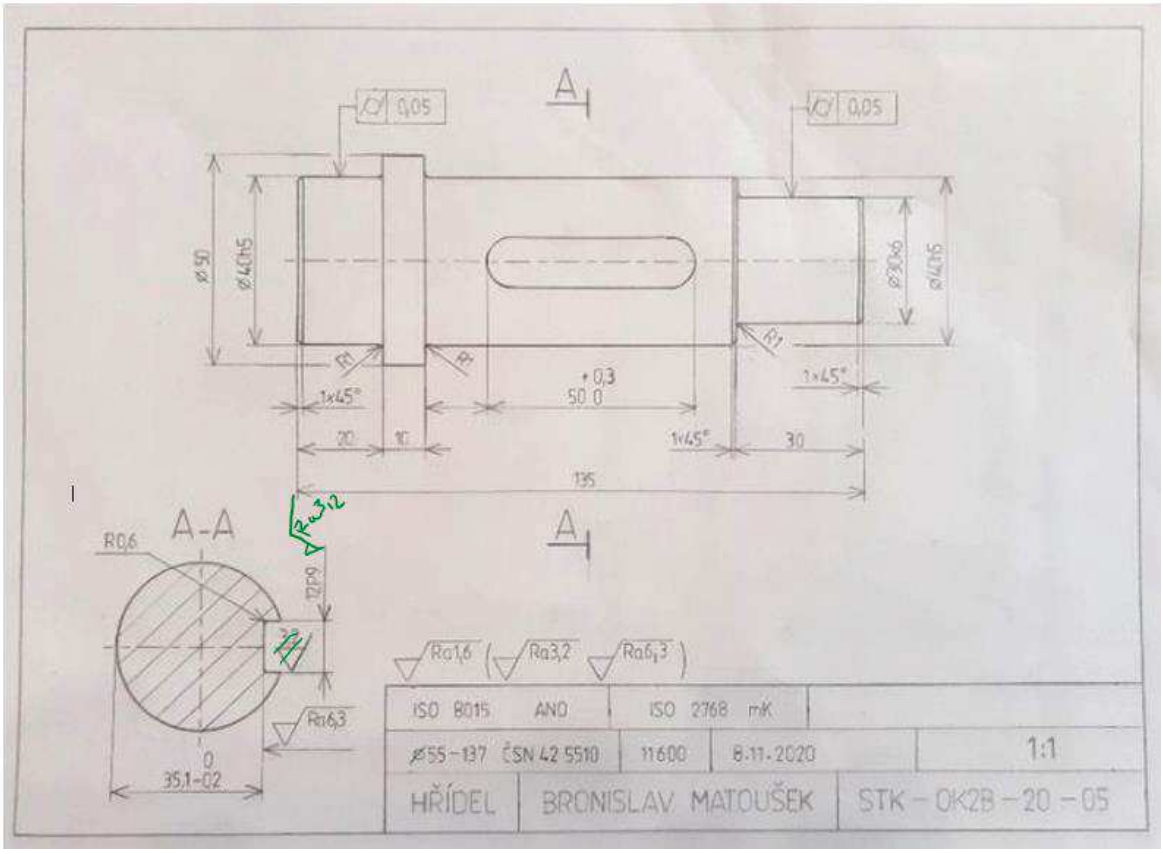
Example of assessing of a shaft drawing with detailed instructions helping the students:



NAKRESLETE VÝROBNÍ VÝKRES HŘÍDELE.

- ✓ Najděte si v tabulkách rozměry a správně okótujte a předepište drsnost povrchu drážky pro pero.
- ✓ Vyplňte všechny potřebné údaje v popisovém poli.
- ✓ Vlevo nad popis. Pole předepište drsnost povrchu
- ✓ Rozlišujte tloušťky čar.
- ✓ Nezapomeňte na osy.
- ✓ Nezadané náležitosti zvolte

Discussion on the drawings with marked notes:



The course of teaching has therefore changed as follows:

- Independent work assignment in Teams - sending the assignment and questions to be answered, (however, instead of 45 minutes I taught this for 90 minutes due to delays caused by sending the work back by the students)
- After the answers were elaborated and sent to Teams, we discussed them via a shared screen. Plotting and highlighting the necessary elements in the read drawing using the graphic tablet.
- Sending an assignment of a 3D display of a students´ manufacturing drawings of the shaft.
- Consultation on the correct choice of the number of images and sections of the shaft drawing, again using a graphic tablet.
- We discussed how did the lesson go
- (After the deadline for submission - discussion on the drawings)

The most difficult, and not entirely possible, was the individual correction of each drawing, as is the case when I receive a drawing on paper and quickly correct errors in it, which the student then, for example photographs on his mobile phone and redraws the drawing correctly. With the remote access, I initially listed the errors in a comment on the assignment submission, but quite a few students were not able to correct the error as described by me. Cutting out all the drawings, typing in the errors, and sending them back was so time consuming that when teaching several classes on technical documentation, I found it impossible to do. In addition, I was creating tutorials and tests for other classes to teach in the iTrivio e-learning application. The consultation I described above had to do.

Feedback on the lesson

As mentioned above, there were several setbacks we had to cope with. I had to think of new ways of communication of the content of the lesson to the students – as far as methods and technological issues were concerned. And the students suddenly found themselves in a very unfamiliar situation. At the beginning of the COVID closure they were skipping classes or pretending being online without actually participating in the classes. Therefore I had to find ways how to assign doable work for them and provide them with feedback. After the initial struggles we managed to find ways how to work together. As the students drew the drawings manually and only sent me photos of their pictures, we avoided any difficulties caused by use of special and potentially expensive programmes, as that would be virtually impossible due to lack of software and hardware for that.

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