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Learning Resources for the course:

Steel Structure Inspector Course for PED INSPECTOR

This document covers only:

Competence unit no. CU-5 GREENER ECONOMICS IN WELDING INSPECTION

Table of Contents

Introduction

The course consists of a number of CU´s. A CU is the smallest element in the education system that specifies Learning Outcomes, Skills and Competence. A CU can be delivered individually or it can be delivered in combinations with other CUs in order to cover a defined range of knowledge and competence.
The course will clarify the inspector's role in manufacturing where it begins well before welding starts, continues during the welding operation, involves action after welding is completed, and is finalized only when the results are properly reported.

The course will be work-based and follows the manufacturing process from the order is received until the welded product is ready for delivery. The inspector is responsible for producing documents that ensure traceability of the components and related manufacturing action throughout this process.

CU5 covers the topic in welding inspection. The costs can be seen as the inspector costs plus overhead. However in this CU the costs of the different inspection methods will be connected also to the welding methods and joint configuration.

The students have to submit all tasks, both practical and theoretical, given through the different course CUs. All CUs have practical tasks for the students. The course requires that the student has access to a workshop where products are manufactured. The products in the workshop will be used during the practical training sessions in this course.

Objective

The objective of this CU is to evaluate the different inspection methods and to select the most environmentally friendly method. However this will also be seen in context with the joint configuration as well as the welding methods used for the fabrication. The inspection costs should also be discussed with reference and experience of the costs of failures and their consequences.

A. Teacher Guideline.

Content of the Teacher Guideline:
The topic for CU 5 is Economics in welding Inspection. It should in general following the EWF Guideline Module 2 item 2.13 where the different cost structures are defined. The learning outcome is to be able to describe the factors affecting welding Inspection costs.

However we envisage that in this CU we also will look at the cost consequences if a failure occur during the fabrication process due to lack of inspection or lack of quality work.

Many manufacturing companies also use general cost figures, like cost per kilo for different methods.

You should let the students present examples of cost calculations from the different companies and compare the cost structures. Advantages and disadvantages can be highlighted.

In the discussions it will be important to see the costs during the manufacturing process and how it accumulated .

B. Students Guideline

The CU 5 covers Economics in welding inspection. We assume that your company already are doing such calculations already. It will be an advantage if you could give the class an example on how you are doing such calculations for different products and different inspection methods.

Of special interest is if you have any examples calculating the cost of repair in production due to an internal failure.

If you have calculations with the real costs for each production step, related to inspection of the product it would be highly appreciated if these can be shared with the other students.

Under folder with “Resources and activities”. The material is available as pdf-files, word- and excel files, and video material (online at YouTube and as mp4 files stored in the learning management system). Please notice that the written assignments should be answered by using the word-files that are embedded into the description of the tasks. **You shall not use** the Office package installed on your own device.

You have 2 weeks to complete each CU. The first week should be preparation activities, while the second week should be used to solve the tasks, exercises and hand in your results to the teacher. The learning activities include *i*ndividual studies, work-based training in your company, group activities, classroom training and a digital Zoom video meeting with the teacher once per week (Saturdays) of using zoom meetings

C. Learning resources

Support resources from selected from the Internet.

Title	Producer	Language	No of pages	Copy-right
Dissecting the welding economy	The Fabricator, March 23,2020	English	10	No

Learning resources developed in the project.

Title	Producer	Language	No of pages	Copyright

General principles of economic in welding	Matrai	English	24	No	
CU5 RPL	Matrai	Hungarian	2	No	

Video resources created for this CU

Title	Producer	Time	Reference	Language	Format	Copy-right

D. Students tasks

Calculation for inspection costs for the product.

* Discuss the extent of inspection at the different steps in the production cycle and its influence on the repair costs.

Submit cost profile/ cost estimate for the inspection of the product that was introduced in CU 2

*Create a repair cost profile depending on where in the production cycle the defects are found.

1. Define a cost budget for inspection of the product

2. Define a repair cost budget for each production stage. (Based on the assumption that previous production stage created a non-conformance)

3. Calculate the inspection costs at the different production stages.

4. Calculate or define the costs for repair at the different production stages.

E. Evaluation

1. Did you find this module relevant ?

* Yes
* No
* I don't know

2. Was it time enough for going through the material ?

* Yes
* No
* I do not know

3. Was the resources relevant for this module ?

* Yes
* No
* I do not know

F. Appendix.

Learning resources developed for this CU.

CU-5

PILOT – Product Inspector Course – 1.8-rev**3**

General principles of economic in welding

CU – 5

Economic in welding Inspection

- Holistic engineering is integrated product development that uses a method of direct progress ("feedforward") toward a goal.You will receive direct feedback from the market.

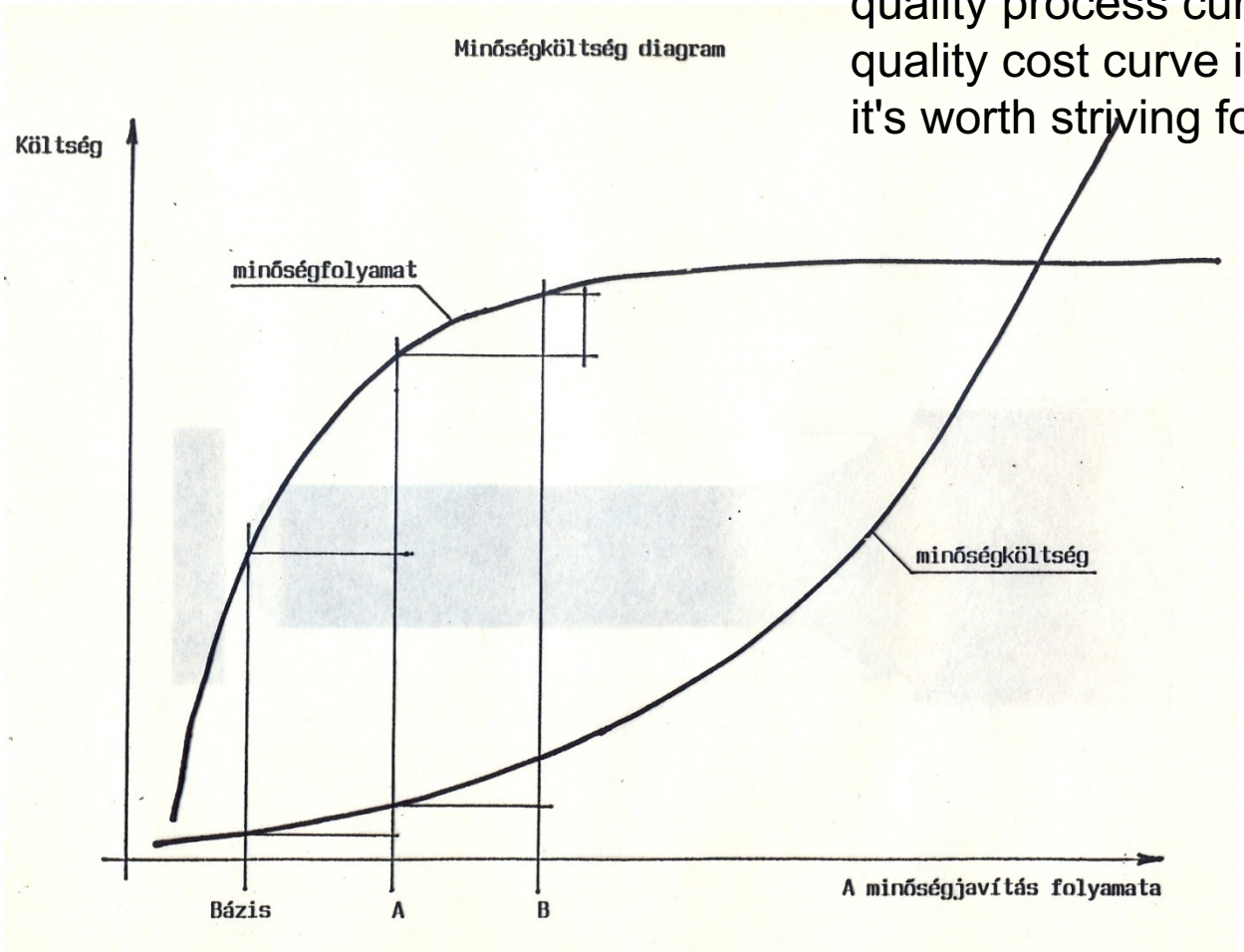
  Thus, using the method of holistic engineering, the developer (inventor) of a new product participates in the implementation of the production (manufacturing, production) and market access sub-processes after product development, with specific tasks - transparency and responsibility.

  This activity fundamentally affects the economic characteristics of the product production process.

Holistic engineering is a comprehensive activity with a multifaceted economic impact.The term “holistic engineering” expresses this process, which consists of several operational elements and is interconnected, with this one word.

CU - 5

The optimum is where the quality process curve and the quality cost curve intersect - it's worth striving for.



CU - 5

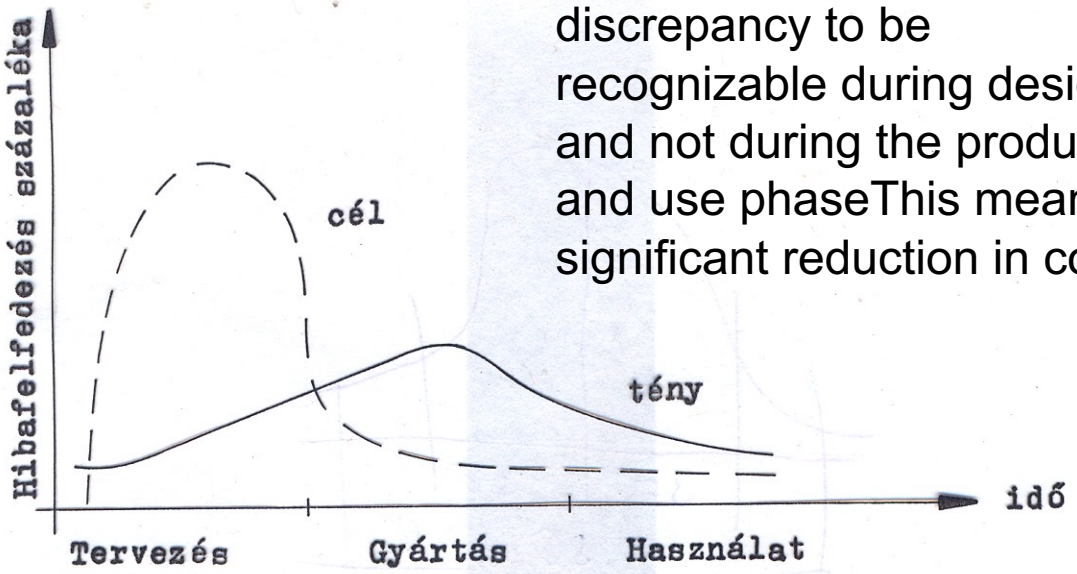
Az IT és a tervezés kapcsolata

Szervezeti síkok	Tervezés	
	fajtája	időhorizontja
vállalati sík	stratégia	év, hónap,
term. vez	taktika	hét,
üzemvez	taktika	nap, órák,
folyamat szabályozás	operatív	min.; s;
üzemi sík	operatív	s; mills

A szervezeten belüli egyes (irányítási) szervezeti síkok és az információs igény és mennyiség kapcsolata:

Szervezeti síkok	Adatátvitel		
	mennyiség	válaszidő	Gyakoriság
vállalati sík	Gbyte	órák	Nap
term.vez	Mbyte	percek	órák
üzem.vez	Byte	másodpercek	percek
folyamat.szabályozás	Bit	100 ms	másodperc
üzemi szint	Bit	millisec	millisec

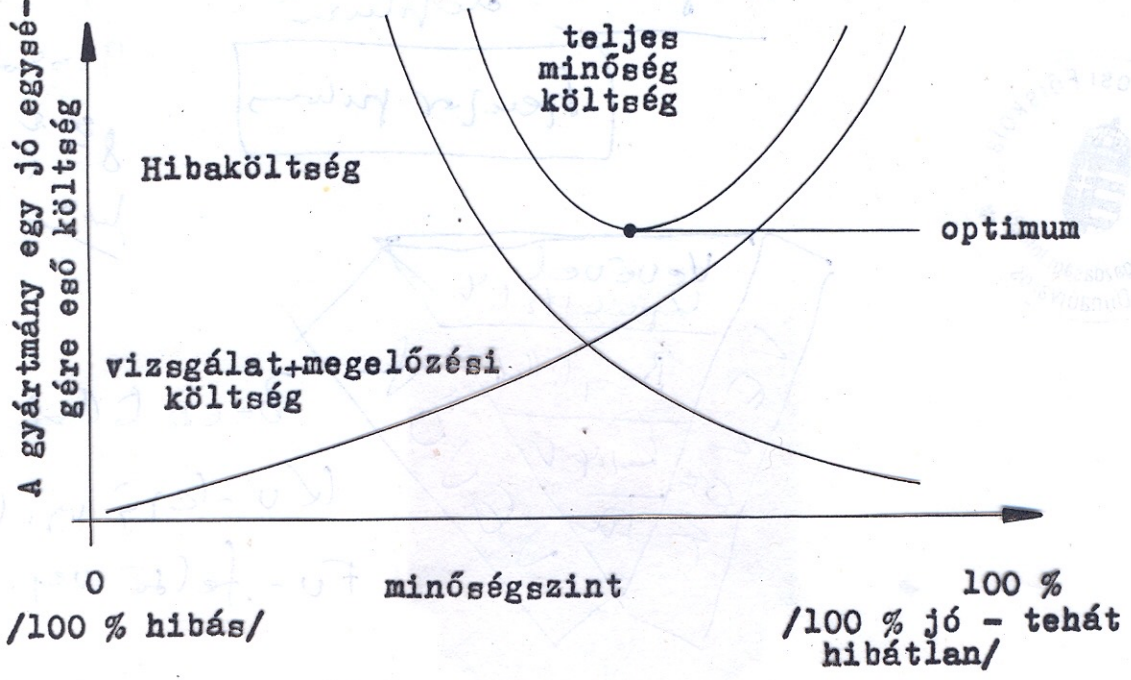
CU - 5



The discrepancy occurs during the life of the product.The goal is for the discrepancy to be recognizable during design and not during the production and use phaseThis means a significant reduction in costs.

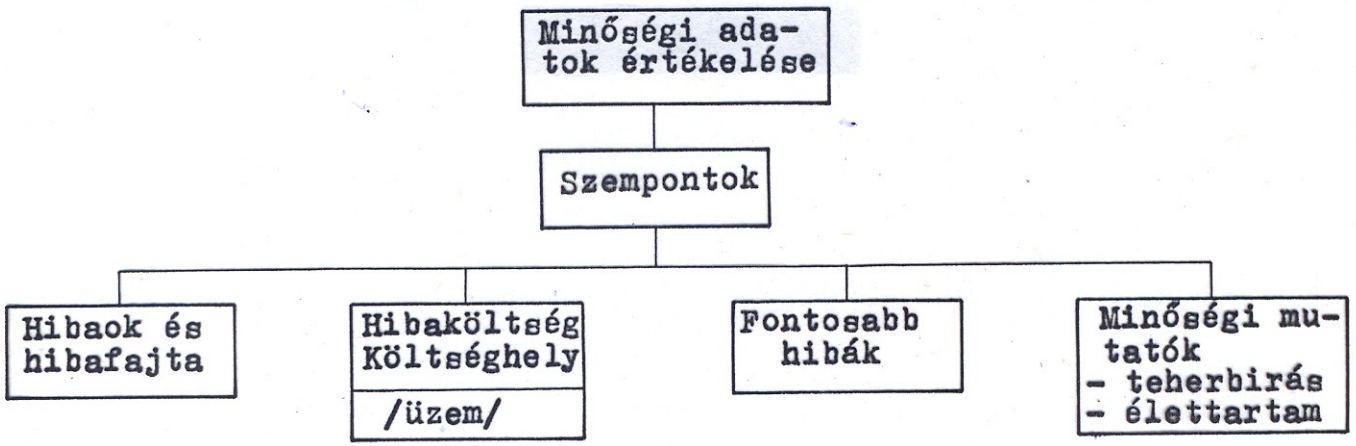
CU - 5

The dynamic relationship between the cost of errors and the cost of testing and prevention



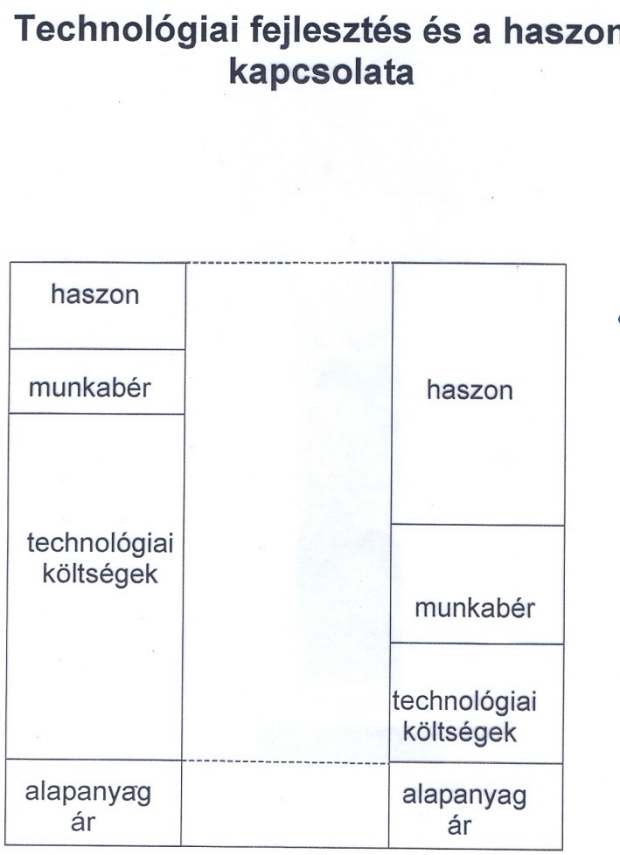
CU-5

Test factors for quality characteristics - and relationship to cost



CU - 5

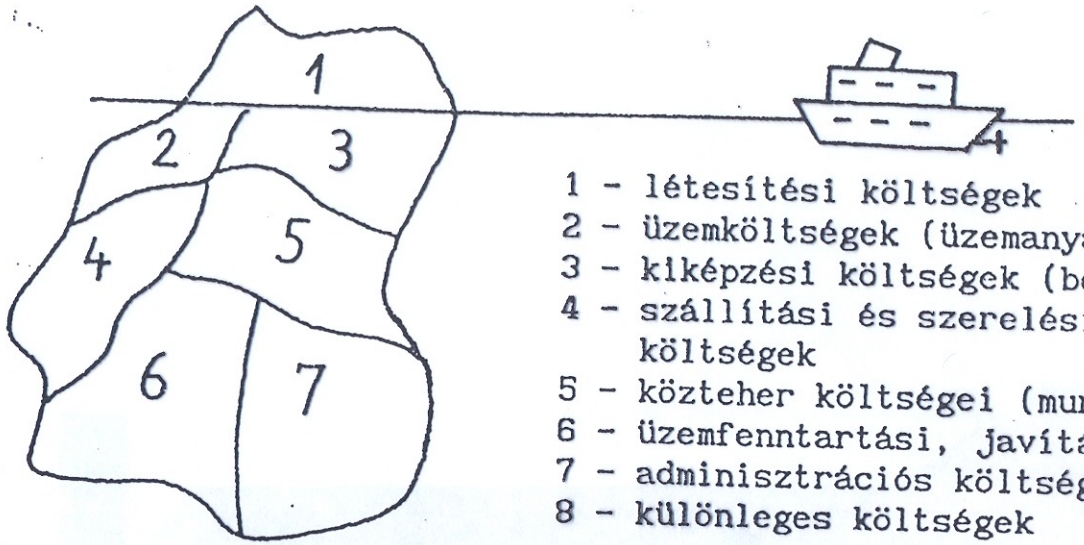
Pre - development status and costs



Well-developed post-development condition and cost

CU - 5

Above “water” (1 - position), only the establishment costs are mostly public (visible), while several existing costs need to be explored.



1 - létesítési költségek
2 - üzemköltségek (üzemanyag, stb.)
3 - kiképzési költségek (betanítás!)
4 - szállítási és szerelési, felállítási költségek
5 - közteher költségei (munkabér, TB)
6 - üzemfenntartási, javítási költségek
7 - adminisztrációs költségek
8 - különleges költségek

1.1. ábra

Költségek fajtái

CU – 5

Quality costs

- Cost of error prevention :
  - During production: inspections,
  - Pre-production: quality planning,
- Troubleshooting costs :
  - Inspection costs,
  - Testing equipment
- Troubleshooting costs :
  - Internal,
  - External,
- Other costs: lost profits, etc.

CU - 5

Types of costs

CU - 5

- **1/ Salary and management costs:**
- Wages :
  - the salary applied to the given undertaking,
- Management (overhead) costs :
  - the cost determined for that company

Comment :

if these are not known numerically, it is advisable to find them elsewhere, e.g. recommended costs in the literature

CU - 5

- **2/ Defrosting power(kg/h)**
- The mass of weld metal produced in one hour by the applied (or planned) welding current
- If the operating factor is 100% - this means that the amount of weld metal that a welder can achieve in one full hour without interrupting (stopping, pausing) welding.

CU - 5

- **3/ Operating factor**

Definition:

Welding power expressed in%, which a welder performs in one working day.

Számítása:

the actual burning time divided by the total number of hours worked and this value multiplied by 100,

EXAMPLE :

if the operating factor is 30%, this means that a welder has spent 30% of his working time in one working day with actual welding

Some (approximate, practical) data :

- 30% for manual arc welding,
- 45% for semi-mechanized shielded arc welding (GMAW, arc welding), and
- automatic shielded arc defrost arc welding for GMAW and FCAW covered arc: up to 60 - 80%,

CU - 5

- **4/ Welding material cost (Ft/kg)**
- The data that is bought for the given product, the use, is the price of the welding consumable.
- If it is not known exactly, it is approximate, estimated, but realistic - e.g. literary value should be used.

CU - 5

- **5/ Defrosting efficiency - LH**
- The part of the welding consumable to be welded from which the weld metal is formed.
- *Not interpreted* :

  without slag, smoke, spatter, wire and hand-coated electrode tip or wire electrode remaining in the feeder,

Calculation :

LH = weight of fused weld metal divided by weight of total welding consumables used (%)

CU - 5

- **5a/ Defrosting efficiency– LH**
  (deposition efficiency)

Defrosting efficiency for some welding processes :

- Covered arc welding : 99%
- Shielded arc fusion arc welding :
  - 98%Ar+2% O_2 98%
  - 75%Ar+25%CO_2 98%
  - CO_2 93%
- Powdered wire : 93%
  - Powdered wire electrode with gas protection : 88%
  - Powdered wire electrode with self-protection : 78%

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- **6/ Specific shielding gas consumption – m^3/h**

Some information :

- at the solid wire electrode : kb. 25 30 m^3/h

- For powdered electrodes with a diameter of 1.6 mm or less : kb. 35 m^3/h

- For powdered electrodes with a diameter greater than 1.6 mm : kb. 40 - 45 m^3/h

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7/ Price of specific shielding gas – Ft/m^3

The price / cost of shielding gas depends :

- from the type of shielding gas,
- the conditions of use / application,e.g. geographical location, liquid state, etc.,

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- **8/ Energy and machine costs (Ft/h)**
- Energy consumption,
- Power supply, wire feeder maintenance and depreciation cost,
- Costs of production, use and maintenance of pistols (welding heads) and other auxiliary devices,

CU -5

Simplified costing

Számítási módszer a hegesztési költségek egyszerű meghatározására

A költségtényezők	Összeg (Ft)
1) Gyártmányhoz szükséges anyag, és az anyagot terhelő általá-nos költségek **anyagköltségek (A)**	A
2) Munkabér és a munkabért terhelő általános és külön költségek **munkabérköltségek (B)**	B
3) **Előállítási költség: (C)**	A+B= C
4) **Önköltség:** Előállítási költség + **Üzemi általános költség (igazgatás, energia, szállítás, stb.)**	C+ $Ü_{ált.\ ks.}$ = D

CU - 5

COST CALCULATION

SOMEADDITIONAL SPECIFIC DATA, INFORMATION:

Lead time definition :

- approx. 35% construction time, material procurement, production preparation time,
- approx. 45% component production, pre-assembly, welding time,
- approx. 20% assembly, final assembly - delivery time,

- Specific data by weight :
  - approx. 3 h / ton - construction time required,
  - approx. 10 h / ton is the production time required,
  - approx. 6 h / ton is the time required for assembly

CU – 5

Additional cost factors related to production - list :

Cost factors - a :

a) strength properties of the raw material, characteristics, e.g. delivery quantity, quality surcharge, or welding and seam properties fitted to the raw material and their costs,

b) implementation of the expected quality characteristics of the welded joint and acceptance of the finished joint test and procedural costs,

c) NDT and post-welding heat treatment,

d) costs related to the qualification of welding processes and other production-related e.g. rating - by an external impartial rating company, etc.,

e) training and qualification of welders and workers,

f) costs of supervision and testing,

g) subcontractor performance costs,

h) heat treatment costs after welding,

i) the cost of manufacturing and using a welding machine,

j) welded joint and surface treatment of the workpiece, e.g. against corrosion effects,

CU – 5

Additional cost factors related to production - list :

Cost factors - b :

a) costs of special welding process application e.g. ensuring complete fusion with root support, etc.,

b) the cost of checking the measurement of geometrical characteristics,

c) learning what is made in-house and what is at the supplier - what are the costs associated with this operation, e.g. travel, inspection costs at the manufacturer's subcontractor,

d) cost effects of weather conditions affecting production conditions e.g. cold, warm rain, windy, etc.,

e) handling non-conformities, discrepancies, errors, e.g. cost management for warranty activities,

f) the subcontractor works under the supervision and responsibility of the main contractor - with an obligation to account for costs,

g) all information relating to his task must be provided to the subcontractor and the costs specified in the supply contract must be borne by the main contractor, in particular the quality information and the technical inspection

h) costs of calibration, validation and verification of measuring equipment, measuring instruments and technological equipment, in particular those directly

CU-5-RPL

RPL – Kérdések – rev 01

CU-5-RPL – ver 01

- RPL – KÉRDÉSEK:
- 1/ Melyek az önköltség összetevői?
- 2/ Mi a műveleti tényező?
- 3/ Melyek a minőségköltségek?
- 4/ Milyen költségfajtákat ismer?
- 5/ Mi a leolvasztási teljesítmény?