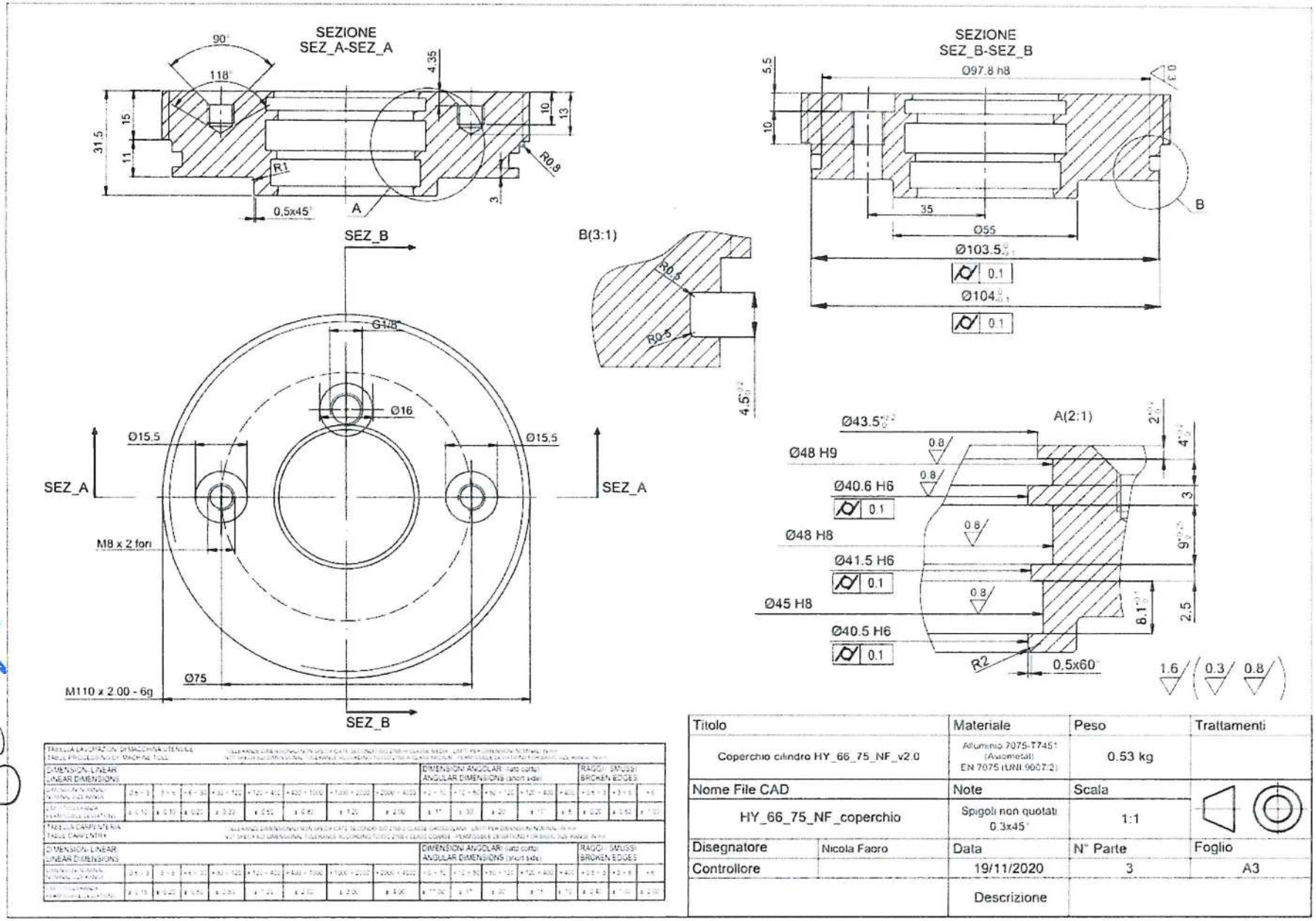
Tema 1

1) Quale è la procedura di misura per verificare le perdite a vuoto di un trasformatore elettrico trifase, noti i dati di targa.
2) Cosa significare collaudare una macchina a fluido? Quali attivita preliminari si dovranno effettuare ai fini del collaudo?
3) Con riferimento al disegno tecnico allegato il candidato formuli una ipotesi di possibili processi di lavorazione per la sua realizzazione in relazione alle tolleranze prescritte.



Titolo		Materiale	Peso	Trattamenti
Coperchio cilindro HY_66_75_NF_v2.0		Alluminio 7075-T7451 (Assimetal) EN 7075 (UNI 9007/2)	0.53 kg	
Nome File CAD		Note	Scala	
HY_66_75_NF_coperchio		Spigoli non quotati 0.3x45°	1:1	
Disegnatore	Nicola Faoro	Data	N° Parte	Foglio
Controllore		19/11/2020	3	A3
		Descrizione		

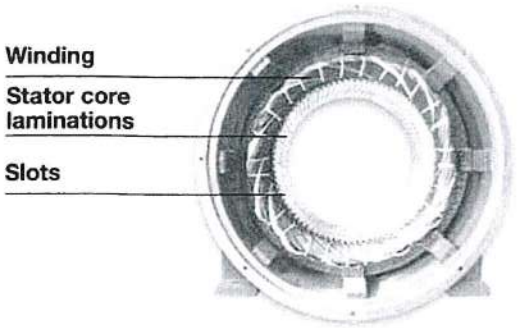
1.2 Structure of the asynchronous motor

In order to understand better how a three-phase asynchronous motor is structured, here is a brief description of the main parts which constitute the rotating machine, i.e. the parts where the electrical phenomena generating the operation originate.

The first element we describe is the stator, which can be defined as the assembly of the fixed parts performing the function of supporting - at least partially - the motor, but fundamentally it constitutes the part of the magnetic circuit which includes the inductor windings housed in special slots made in correspondence with its internal surface. The stator, shown in Figure 1, is constituted by silicon steel alloy or by steel laminations, insulated one from the other. From its structure it depends how much it is affected by time-variable magnetic flows which cause losses due to hysteresis (linked to the nonlinear magnetization of the material) and to induced "eddy currents".

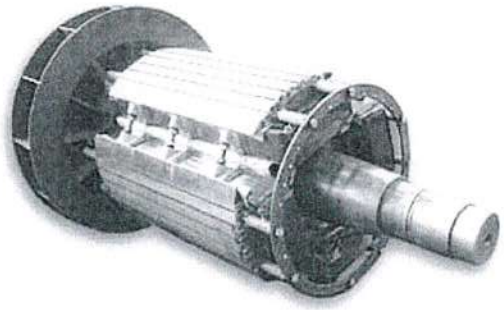
In the slots obtained in the structure of the laminations, three primary windings are inserted (each of them constituted by more coils differently connected between them), to which the supply voltage is applied and which generate the magnetic field. The three-phase stator windings can be star- or delta-connected; this can be achieved with motors equipped with terminal box with 6 terminals, so that it is possible to feed the same motor with different three-phase network voltages. An example of double indication could be 230VΔ - 400VY or 400VΔ - 690VY, where the symbol Y or Δ refer to the connection of the stator windings; for example, taking into consideration the second case (400VΔ - 690VY), the indication means that the delta-windings of the motor can be connected to a three-phase network at 400V (phase-to-phase voltages), whereas, if for the same motor the windings are star-connected, the motor itself can be connected to a supply network at 690V (the star-windings shall be subjected to the network voltage reduced by $\sqrt{3}$ times).

***Figure 1**: Stator of a three-phase asynchronous motor*



The second element is the rotor, which is positioned inside the stator and constitutes the induced circuit of the motor. For a squirrel-cage motor, the rotor - as represented in Figure 2 – is constituted by a system of bars (in copper or aluminum), which are coaxial to the rotation axis and directly die-cast in the slots made along the external periphery of the ferromagnetic; they are closed in short-circuit by two rings located on the extremities and constituting also a mechanical fixing. Thus, an extremely compact and robust rotor is obtained, to which also the motor shaft is fixed.

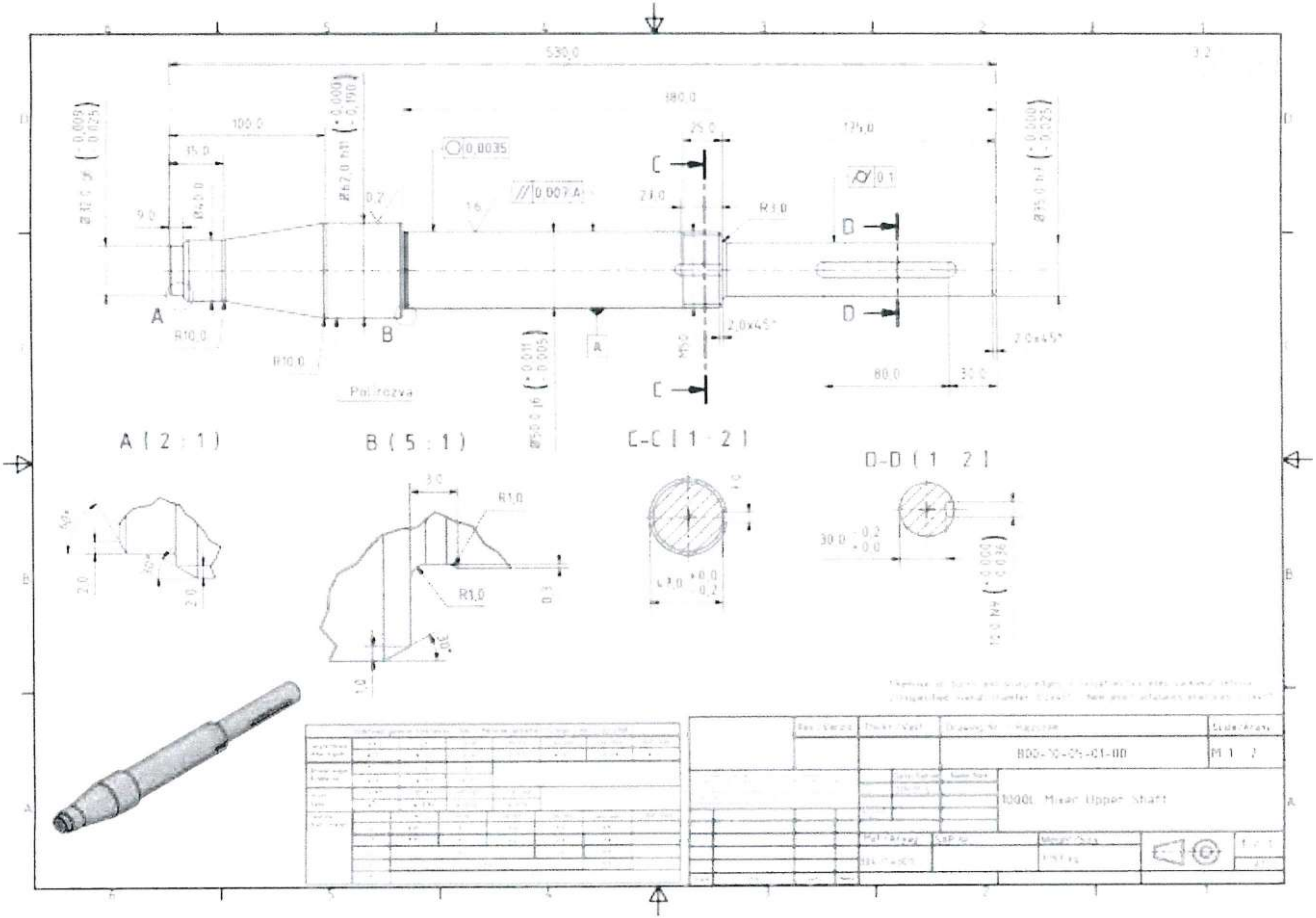
***Figure 2**: Rotor of a three-phase asynchronous motor*



The induced magnetic field, which constitutes the operation principle of the motor, makes the motor shaft rotate, thus converting the electrical energy into mechanical energy.

Tema 2

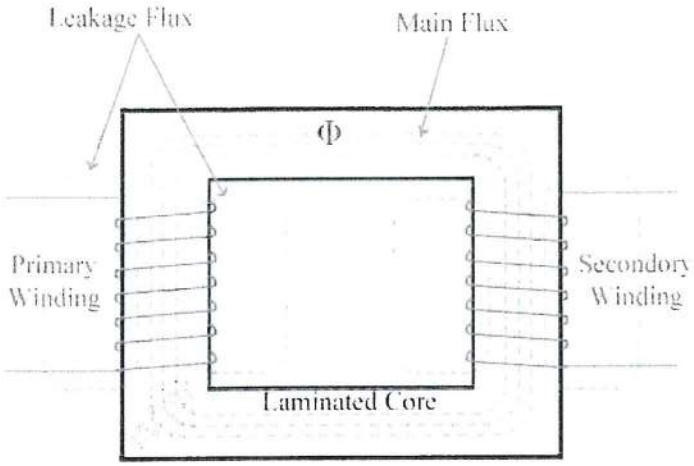
1) Identificare la strumentazione necessaria per una misura volt-amperometrica di potenza in un sistema trifase, descrivere lo schema di collegamento della strumentazione nel circuito.
2) Quali sono i componenti principali di un impianto per il collaudo di una pompa centrifuga?
3) Con riferimento al disegno tecnico allegato il candidato formuli una ipotesi di possibili processi di lavorazione per la sua realizzazione in relazione alle tolleranze prescritte


530,0
380,0
100,0
35,0
25,0
175,0
0,0035
0,007 A
A (2 : 1)
B (5 : 1)
C-C (1 : 2)
D-D (1 : 2)
Polirezva
800-10-05-01-00
M 1 : 2
1000L Mixer Upper Shaft

Transformer

electrical transformer is a static electrical machine which transforms electrical power from one circuit to another circuit, without changing the frequency. Transformer can increase or decrease the voltage with corresponding decrease or increase in current.

Working principle of transformer



The **basic principle behind working of a transformer** is the phenomenon of mutual induction between two windings linked by common magnetic flux. The figure at right shows the simplest form of a transformer. Basically a transformer consists of two inductive coils; primary winding and secondary winding. The coils are electrically separated but magnetically linked to each other. When, primary winding is connected to a source of alternating voltage, alternating magnetic flux is produced around the winding. The core provides magnetic path for the flux, to get linked with the secondary winding. Most of the flux gets linked with the secondary winding which is called as 'useful flux' or main 'flux', and the flux which does not get linked with secondary winding is called as 'leakage flux'. As the flux produced is alternating (the direction of it is continuously changing), EMF gets induced in the secondary winding according to Faraday's law of electromagnetic induction. This emf is called 'mutually induced emf', and the frequency of mutually induced emf is same as that of supplied emf. If the secondary winding is closed circuit, then mutually induced current flows through it, and hence the electrical energy is transferred from one circuit (primary) to another circuit (secondary).

Basic construction of transformer

Basically a transformer consists of two inductive windings and a laminated steel core. The coils are insulated from each other as well as from the steel core. A transformer may also consist of a container for winding and core assembly (called as tank), suitable bushings to take our the terminals, oil conservator to provide oil in the transformer tank for cooling purposes etc. The figure at left illustrates the basic construction of a transformer. In all types of transformers, core is constructed by assembling (stacking) laminated sheets of steel, with minimum air-gap between them (to achieve continuous magnetic path). The steel used is having high silicon content and sometimes heat treated, to provide high permeability and low hysteresis loss. Laminated sheets of steel are used to reduce eddy current loss. The sheets are cut in the shape as E,I and L. To avoid high reluctance

Tema 3

1) Illustrare la procedura di misura per verificare le perdite in cortocircuito di un trasformatore elettrico trifase, noti i dati di targa.
2) Quale è il principio di funzionamento di una pompa centrifuga?
3) Con riferimento al disegno tecnico allegato il candidato formuli una ipotesi di possibili processi di lavorazione per la sua realizzazione in relazione alle tolleranze prescritte

14.9 GOVERNING OF HYDRAULIC TURBINES

Hydraulic turbines drive electrical generators in power plants. The frequency of generation has to be strictly maintained at a constant value. This means that the turbines should run at constant speed irrespective of the load or power output. It is also possible that due to electrical tripping the turbine has to be stopped suddenly.

The governing system takes care of maintaining the turbine speed constant irrespective of the load and also cutting off the water supply completely when electrical circuits trip.

When the load decreases the speed will tend to rise if the water supply is not reduced. Similarly when suddenly load comes on the unit the speed will decrease. The governor should step in and restore the speed to the specified value without any loss of time.

The **governor should be sensitive** which means that it should be able to act rapidly even when the change in speed is small. At the same time **it should not hunt**, which means that there should be no ups and downs in the speed and stable condition should be maintained after the restoration of the speed to the rated value. It should not suddenly cut down the flow completely to avoid damage to penstock pipes.

In hydraulic power plants the available head does not vary suddenly and is almost constant over a period of time. So **governing can be achieved only by changing the quantity of water that flows into the turbine runner**. As already discussed the water flow in pelton turbines is controlled by the spear needle placed in the nozzle assembly. The movement of the spear is actuated by the governor to control the speed. In reaction turbines the guide vanes are moved such that the flow area is changed as per the load requirements.

Hydraulic system is used to move the spear in the nozzle or to change the positions of the guide blades because the force required is rather high.

The components of governing system are

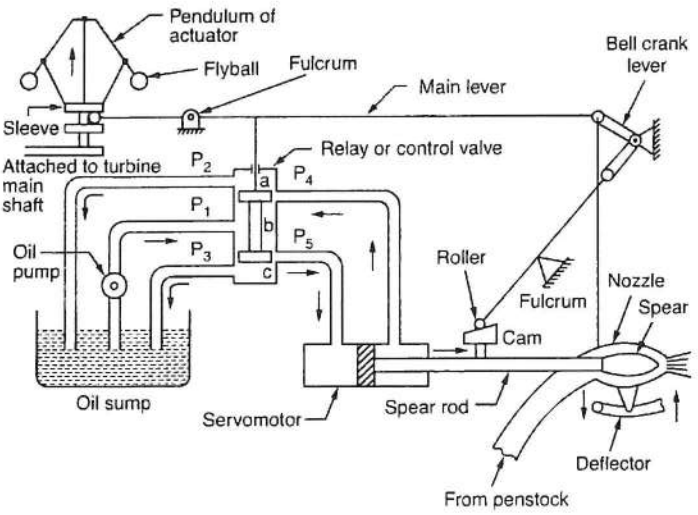
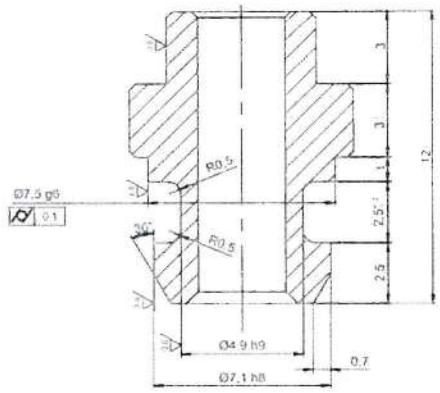


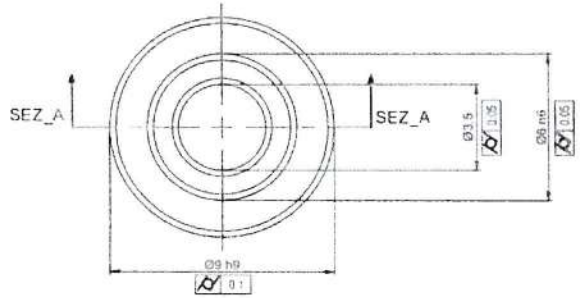
Figure 14.9.1 Governing system for Pelton turbine

Tema 4

1) Descrivere la procedura di misura per verificare il rendimento di un motore asincrono trifase.
2) Cos'è la mandata di una pompa centrifuga?
3) Con riferimento al disegno tecnico allegato il candidato formuli una ipotesi di possibili processi di lavorazione per la sua realizzazione in relazione alle tolleranze prescritte

SEZIONE
SEZ_A-SEZ_A





1.6 (0.3 0.8)

Titolo		Materiale	Peso	Trattamenti
Spina corta cilindro HY_66_75_NF_v2.0		EN 1.4401 (AISI 316)	0.003 kg	
Nome File CAD		Note	Scala	
HY_66_75_NF_spina_1		Spigoli non quotati 0.3x45°	6:1	
Disegnatore	Nicola Faoro	Data	N° Parte	Foglio
Controllore		15/11/2020	9	A4
		Descrizione		

14.6 PELTON TURBINE

This is the only type used in high head power plants. This type of turbine was developed and patented by L.A. Pelton in 1889 and all the type of turbines are called by his name to honour him.

A sectional view of a horizontal axis Pelton turbine is shown in figure 14.6.1. The main components are (1) The runner with the (vanes) buckets fixed on the periphery of the same. (2) The nozzle assembly with control spear and deflector (3) Brake nozzle and (4) The casing.

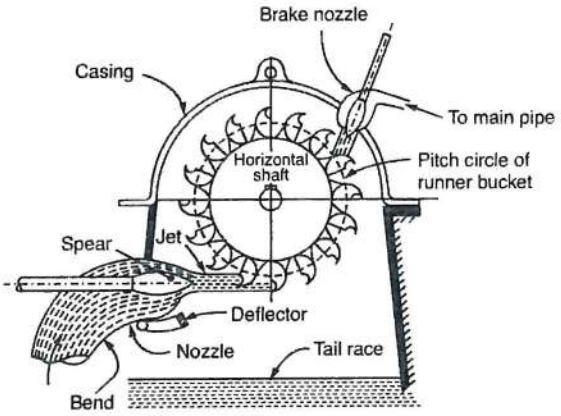


Figure 14.6.1 Pelton turbine

The rotor or runner consists of a circular disc, fixed on suitable shaft, made of cast or forged steel. Buckets are fixed on the periphery of the disc. The spacing of the buckets is decided by the runner diameter and jet diameter and is generally more than 15 in number. These buckets in small sizes may be cast integral with the runner. In larger sizes it is bolted to the runner disc.

The buckets are also made of special materials and the surfaces are well polished. A view of a bucket is shown in figure 14.6.2 with relative dimensions indicated in the figure. Originally spherical buckets were used and pelton modified the buckets to the present shape. It is formed in the shape of two half ellipsoids with a splilter connecting the two. A cut is made in the lip to facilitate all the water in the jet to usefully impinge on the buckets. This avoids interference of the incoming bucket on the jet impinging on the previous bucket. Equations are available to calculate the number of buckets on a wheel. The number of buckets, Z,

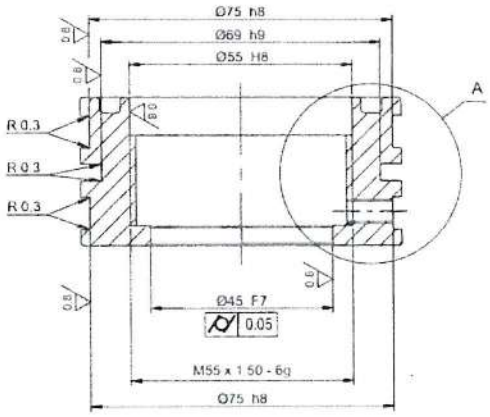
$$Z = (D/2d) + 15$$

where D is the runner diameter and d is the jet diameter.

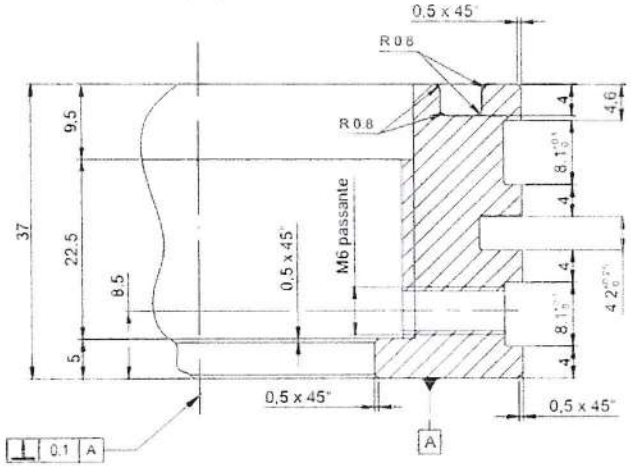
Tema 5

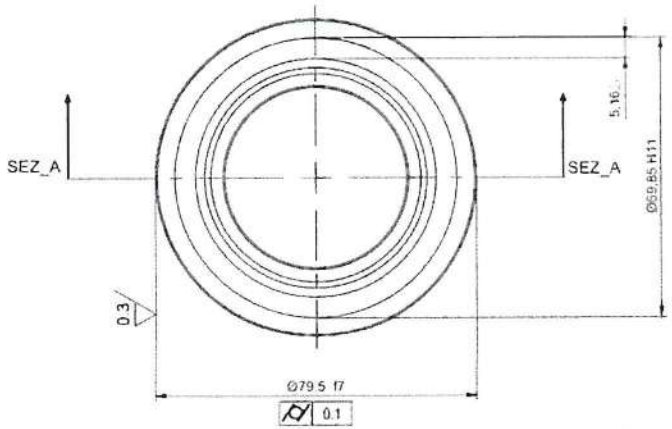
1) Spiegare in che modo viene garantita la protezione dai contatti indiretti nei sistemi in Bassa Tensione di tipo TN (utenza alimentata dalla rete di Media Tensione tramite cabina MT/BT di proprieta dell'utente).
2) Si descriva la strumentazione da utilizzare in un impianto di prova per macchine idrauliche, il suo posizionamento nell'impianto e le modalita di installazione degli strumenti per una misurazione più accurata.
3) Con riferimento al disegno tecnico allegato il candidato formuli una ipotesi di possibili processi di lavorazione per la sua realizzazione in relazione alle tolleranze prescritte

SEZIONE
SEZ_A-SEZ_A



A(2:1)

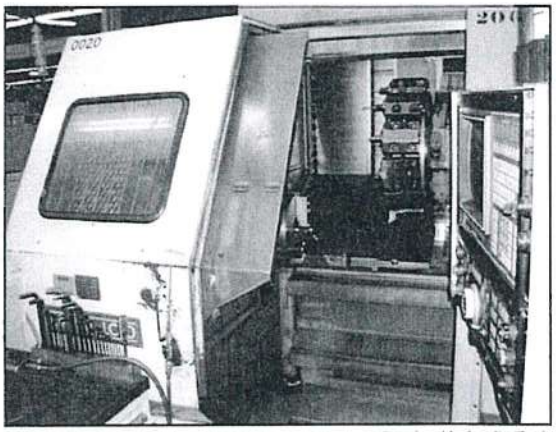




1.6 (0.3 0.8)

Titolo		Materiale	Peso	Trattamenti
Testata pistone cilindro HY_66_75_NF_v2.0		C40 - UNI 7845	0.75 kg	
Nome File CAD		Note	Scala	
HY_66_75_NF_TESTATA_PISTONE		Spigoli non quotati 0.3x45	1:1	
Disegnatore	Nicola Faoro	Data	N° Parte	Foglio
Controllore		11/11/2020	6	A3
		Descrizione		

CNC turning machine



Stanley Hydraulic Tools

Computer numerically controlled (CNC) machining centers cut and shape an assortment of precision products from automobile parts to general machine parts. Operating in either horizontal or vertical positions, CNC machinery includes machining tools such as lathes, multi-axis spindles, and milling and boring machines; the functions formerly performed by human operators are performed by a computer-control module. CNC machinery is either hand loaded or automatically fed.

Most CNC machinery is partially or totally enclosed by metal enclosures equipped with thermoplastic vision panels, most commonly polycarbonate.

Hazard

Two primary hazards arise from CNC turning operations: Entanglement and the ejection of parts. Serious lacerations, fractures, amputations, or even death can occur if an operator contacts or becomes entangled in or between the tooling or rotating work piece. Similar injuries or death can also occur from being struck by ejected parts (e.g., cutters or other tools, chucks, or the work piece).

Although the risk of injury from ejected parts is lessened due to the interlocked enclosure of CNC machinery, recent research has shown that polycarbonate materials used in the unit's vision panels can degrade after exposure to the metalworking fluids and lubricants used in the machining process. Over time, vision panels may not be able to contain ejected parts. Most ejections at CNC turning machines are caused by a setup error or failing to properly maintain work-holding devices.

Unexpected movement or startup caused by faults in the control system can also cause serious injury.

Solution

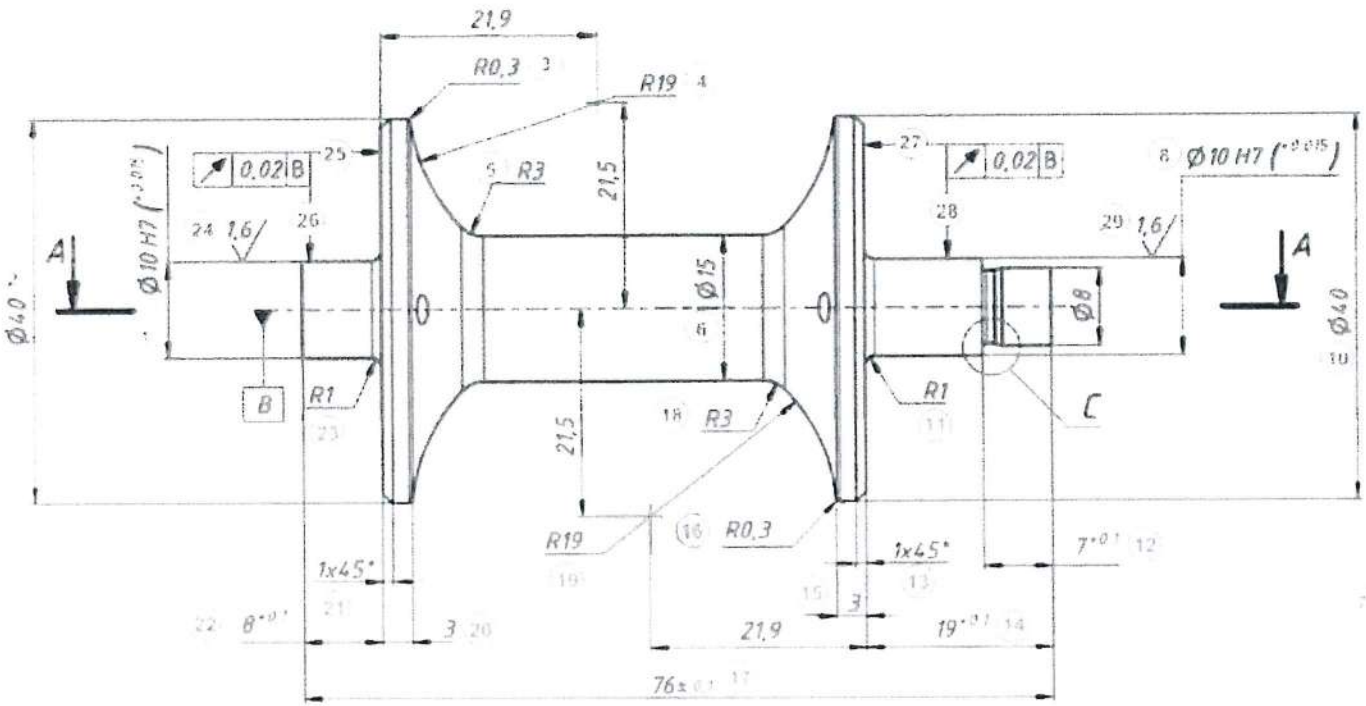
To prevent access into the point of operation area, ensure the CNC machine is fully enclosed and equipped with an interlocked guard (door). The cutting tools should not start unless the door is in position and should stop when the door is opened. Many machines lock the guard in position during operation and can only be opened when the tooling stops. If access into the point of operation is infrequent, install a fixed enclosure that can be removed only for maintenance activities.

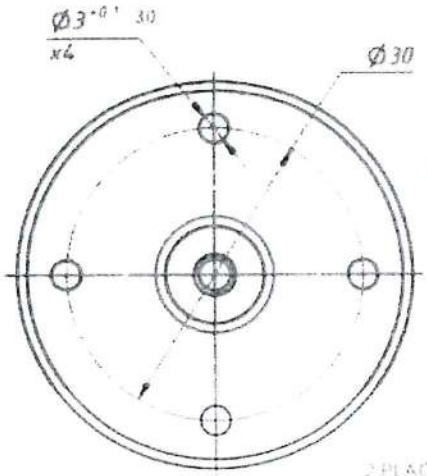
Automatic loading and unloading methods and automatic tool changing further reduce the exposure to the point of operation.

To prevent injury from ejected parts, make sure the polycarbonate vision panels are strong enough to contain ejected parts. Also, verify the appropriate rotational speed for the particular work piece and inspect the chuck jaw assemblies, work piece clamps, and all component parts of the turning fixtures.

Tema 6

1) Descrivere l'interruttore differenziale, illustrare le sue caratteristiche nominali e indicarne alcuni usi tipici nelle reti elettriche in Bassa Tensione. Che cos'è un interruttore salvavita?
2) Qual è il principio di funzionamento di una turbina Francis?
3) Con riferimento al disegno tecnico allegato il candidato formuli una ipotesi di possibili processi di lavorazione per la sua realizzazione in relazione alle tolleranze prescritte





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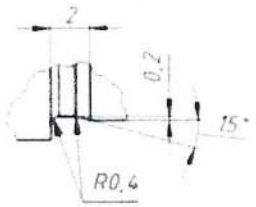
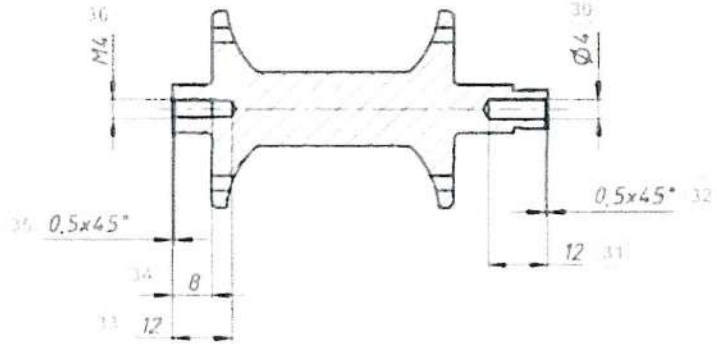


A-A (1 : 1)



General tolerance DIN ISO 2768 -medium.
Deburr and break sharp edges 0,1...0,3mm.
Scratches and dents are not acceptable.

3,2 (√)

			Gewicht	Format
				A3

	Date	Initiale	xometry_lathe_sample_v2 0 (1)
Draw.			
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Material: Stainless Steel			Z 1

2.4 – General Safety Practices

Rules for a safe workplace:

- Never use any equipment which you have not been trained to operate by a qualified person.
- Never tamper with a machine safety guard or switch.
- Get into the habit of constantly tidying the workspace. A clean workplace is safer. Random metal can not only scratch and ruin finished parts, they can cause severe cuts.
- Use caution when handling cutting tools. They are very sharp. Never handle a tool by its cutting flutes.
- Never start orjog the machine until you have checked that the work area is clear.
- Never push the start button on the machine unless you are certain your setup is capable of safely holding the part against all cutting forces during machining.
- Use caution when running a new program: especially at the start of program and after a tool change.
- Know where the emergency stop is on the machine and practice using it before you need it.
- Never run a machine alone or without other people within hearing distance.
- When working with someone else at the machine, clearly communicate who is running the machine.
- Never have one person touching the control while the other is working in the machine envelope.
- Use a paint brush to sweep away sharp chips. Never use your hands or a rag.
- Never use an air hose to clear chips from a machine. Flying chips are dangerous to you and others.
- Liquids spills are slipping hazards. Clean spills immediately.
- Dirty or oily rags must be stored in a fireproof canister. These can spontaneous combust and cause a fire.
- Lift with your legs, not your back.
- Never lift anything more than you can comfortably handle.
- Get help handling heavy or bulky objects.
- At the end of the program, command the machine to position the part close to the operator so it can be easily reached without leaning far into the CNC machine.
- Never leave a running machine untended.
- Before shutting the machine down, remove any tools from the spindle.
- Avoid contact with coolant. Water-based coolant contains microbes that can cause infection.
- Immediately treat and cover even minor cuts.
- Report any injuries immediately.
- Remain alert. Think safety in everything you do.

2.5 CNC Safety Practices

Use these extra precautions when running a CNC program for the first time:

- Use machine Rapid and Feed override controls to slow the machine down.
- A major cause of crashes is setting the tool or fixture offset incorrectly. Pay particular attention to moves at the start of program and immediately after a tool changeas the tool moves towards the part. Use single-block mode to advance through the program one line at a time until the tool is at cutting depth.
- Remain at the machine with a hand on or near the emergency stop button.
- Stop machine motion at the first sign of trouble.